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Trade Expansion Measures.

ALTHOUGH we are just now in the midst of the holiday season and many business men, like politicians, judges, lawyers and jurors, are on vacation recuperating for busy days to come, the time is appropriate for directing attention to a number of matters connected with overseas trade development.

First, the ELECTRICAL REVIEW as a journal which has always believed in the ability of the Department of Overseas Trade to render valuable export assistance to British industry and has given cordial support to its efforts to that end, desires to congratulate Sir Edward Crowe, C.M.G., upon his appointment to be Comptroller-General of that Department in succession to Sir William Clark. Sir Edward, who took up his duties on August 1st, may be said to have been born and cradled in Consular life, as can be seen from the record of his forbears, while his personal official record includes appointments in the Far East or elsewhere as Commercial Attaché, Commercial Counsellor, or as a Vice-Consul before he became Director of the Foreign Division of the D.O.T. in 1924. We hope that coming events will demonstrate that added to all his overseas experience he possesses such a grasp of our trade situation and problems as will enable him as Comptroller-General to secure approval and support from above for the exercise of enterprise and initiative, and encouragement to leave the beaten path as occasion demands. May we bespeak for the electrical industry a full measure of co-operation from Sir Edward and his staff? We believe that we may.

At the very moment of expressing these views there lies before us, appropriately enough, a communication from the Department itself, which suggests once more, as we ourselves have frequently done, that however thoroughly the Department may do its work in placing assistance at the command of traders, such can be of little real value unless the latter whole-heartedly avail themselves of the personnel and material that are placed at their disposal. The letter before us directs attention to the facilities which the Trade Commissioner Service can render to representatives of British firms visiting India. H.M. Senior Trade Commissioner in India, Mr. T. M. Ainscough, C.B.E., and his colleagues, Major R. W. Clarke at Bombay, and Mr. W. D. M.

Clarke at Calcutta, are particularly anxious to meet visitors from the United Kingdom, as they feel that with their organisation in India they are in a good position to render considerable assistance either to principals undertaking a special investigation of the market, or to commercial representatives who are developing the sale of British goods in India. It should be understood, therefore, that any member of any firm who may be contemplating such a visit (and the usual time for such visits is at hand) can, on application to the Department, be provided with letters of introduction to the Commissioners named. In addition, the officers of the Department in London will be pleased to discuss any proposed trip with a view to rendering help not only as regards market conditions in India at the present time, but also if desired, regarding itinerary, outfit, &c.

What has been said in regard to the Indian market is equally applicable in regard to other Colonial and foreign fields of activity, and we commend the Department and its representatives to the notice of every concern that is engaged in efforts for further expansion of electrical export trade in the coming months. In the past there has been apathy on the part of some concerns which, more through inexperience than anything else, we should say, have failed to make use of the service prepared for them both at home and abroad.

Next, we may make a passing reference to the British Industries Fair of February-March, 1929. On the eve of the holidays, Mr. Vyle, the popular head of the Associated Chambers of Commerce, appealed to business men not to depart for the vacation without settling their space policy and requirements. We hope that the appeal caught the eye of electrical men, or if not, that these lines will somehow come under the notice of those who have authority to act in their absence. Mr. Hacking, of the D.O.T., and others interested in the Fair movement have been making speeches or issuing statements which lead us to expect a finer Fair than ever, both in London and Birmingham, with a still better total of overseas buyers. We trust that the electrical trade will fill a larger place next year, as regards both exhibitors and buyers, than on any previous occasion.

The final matter to which we would allude here is the coming departure of the mission, of which Sir Hugo Hirst, Bart., is an important member, and which is proceeding to Australia.

Sir Hugo, in addressing G.E.C. shareholders early last month, explained that the Mission was appointed to study—in conjunction with Australian experts—not only how to improve the business relations between two of the most important parts of the British Empire—Australia and the Mother Country—but also how to increase the productivity and prosperity of each without detriment to the other. We take this opportunity of wishing Sir Hugo and his colleagues a very successful tour of investigation. We hope that they will make such discoveries regarding the trade relations between Australia and the Mother Country that recommendations of lasting value to the electrical and other industries may eventuate which shall tend in some degree to solve one of the greatest, if not the greatest, of all problems confronting the population of these islands—that of securing prosperous employment.

Obsolete Plant in Rolling Mills.

It is not often that a manufacturer will confess that the methods employed in his works are obsolete, but iron and steel manufacturers—and also certain re-rollers—have admitted recently that the plant in their works is not up-to-date, and that this is one reason why Continental competitors are beating us even in our home markets. The Germans, for instance, are said to be ahead of us in coke-oven plant. We understand that the production of steel per ton of coal is much lower in this country than on the Continent, and another cause of waste is found in machinery driving methods. It is difficult to understand why rolling mills for plates or bars should not all be electrically driven, and each machine independently. Not long ago a large re-rolling plant, a wire-drawing works, and a tube and rod works were visited, and in none of these had the electric drive been adopted. In the tube and rod mill it was stated that the general manager could not be convinced that the independent driving of each draw bench would be the most profitable. In these works it sometimes happens that a percentage of the draw benches are not employed—indeed, 50 per cent. of them have at times been idle—yet the same steam power is required to drive the line shaft. Further, it occasionally happens that a breakdown of one machine will hold up all the other machines. Anyone with the slightest knowledge of production costs in a metal manufacturing works realises that it is only by maintaining the maximum production that overhead and other charges can be met. In many bar and plate mills the same condition of things exists. It is almost inconceivable that any manufacturer should fail to realise that on the power plant depends to a great extent the general efficiency of his works.

Industrial and Domestic Loads.

In connection with any prevailing idea or scheme there is always the danger of obsession, and on this score a word of warning with reference to domestic electricity supply may not be untimely. The outstanding note in the recent electrical conferences in this country has been "domestic electricity," and quite rightly, for in that direction lies a vast almost unexplored field for activity and enormous possibilities for load development; but is there a danger of neglecting the industrial load? We refer particularly to what may perhaps be called the "residential-industrial" load, embodying the hundred-and-one local-supply services for the residential area—bakers' and confectioners' mixing machines, laundry-machine driving, the local builders' requirements, and so on. Almost from the commencement of public electricity supply there has always been steady progress in industrial electrification, not always welcomed by the supply engineer, and such progress has perhaps come to be looked upon as satisfactory. The credit for this has often rested more with the obvious advantages of the electric drive than with the business-getting efforts of the supply undertaking.

The extension of domestic electrification has brought with it new methods of business "push," and practically all supply engineers are turning their energies in that direction; but the power load must not be left to look after itself, for competition in that connection is still keen, and remarkable strides have been taken in recent years in the development of the oil engine. Modern business methods should apply to all branches of the industry. It is still likely that the load possibilities of small industrial consumers are not fully realised, and it is for the supply engineer to explore the field exactly as he is doing in connection with the domestic services.

There is a tendency perhaps for engineers to believe that in the domestic supply lies the means of overcoming all the load-factor difficulties. Such an attitude is to be deprecated: in a discussion during the recent Centenary Conference of the Institution of Civil Engineers, Mr. F. W. Purse (engineer and manager, West Ham) issued a warning on this question, pointing out that it was the load factor combined with the total output, and not the load factor alone, which counted. Again, in their paper at the I.M.E.A. Conference at Bath, Messrs. J. L. Carr and J. D. Peattie showed the advantages of a "mixed" load over the purely domestic load.

Above all, there is still plenty of new and profitable business in the industrial-power line for the supply engineer—if he will go out and get it.

Photo-Telegraphy.*

A brief descriptive outline of the various methods of transmission and reception which make use of the controlling effect of varying light tones on the illumination falling upon a photo-sensitive cell, and also those employing mechanical methods.

By T. THORNE BAKER.

THE transmission of a photograph by telegraphy was first accomplished over twenty-two years ago, and reached a very high state of technical perfection. Why the process was allowed to stagnate for nearly twenty years it is difficult to say, but it is only during the last two or three years that newspapers have once again taken up the telegraphy of pictures.

The telegraphic transmission of at least sixteen images a second constitutes *television*, but the images must be

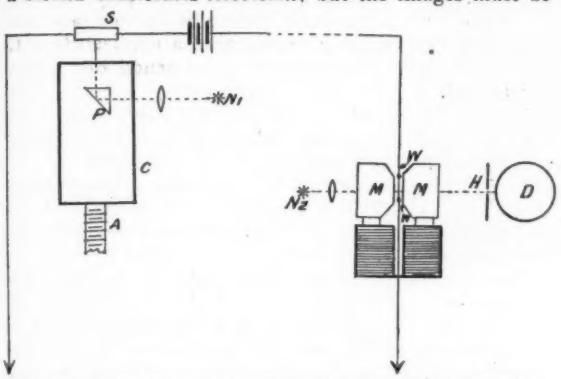


Fig. 1.—Arrangement of Transmitting-Receiving System.

those of an original subject, and not a photographic representation. The picture transmitted must be that, for instance, of a person sitting in front of the apparatus, without the intervention of a camera, and at the receiving instrument the received images must be thrown into an eyepiece or projected upon a screen, again without the aid of photography or any recorder.

Photo-telegraphy and television are therefore closely allied, and, although the former is at present carried out by means entirely different from those employed in television, it is quite likely that before long the technique adopted for television will be made to serve the dual purpose.

The first attempts at photo-telegraphy were a natural sequel to the discovery of the light-sensitiveness of the element selenium. The discovery that its conductivity not only increased on exposure to light, but that—over a considerable range—the conductivity was also actually proportional to the light intensity, made it evident that here was a method of converting the various tones of a photograph into electrical signals of corresponding strength. The art of telegraphy was quite sufficiently advanced to make the recording of the signals a simple matter, the only remaining problem being that of the synchronisation of the sending and receiving instruments.

In modern systems of photo-telegraphy such as we shall now describe, the selenium cell has given place to the photo-electric cell, which is far quicker in its response to changes in the strength of illumination falling upon it, and therefore allows of far finer details in the photograph being faithfully recorded. Except for this difference, and for advances in both instrumentation and electrical methods of dealing with minute currents, the modern processes do not vary greatly from the system of Professor A. Korn, which was established for commercial newspaper work by the *Daily Mirror* between Paris and London in November, 1907.

The transmitting instrument consists essentially of a glass cylinder C (fig. 1) to which can be attached a photographic transparency. This may be either a negative or a positive. This cylinder is mounted on a threaded spindle, A, the thread working in a fixed nut, so that as the cylinder revolves it travels along its own axis. An electric lamp, N_1, is provided with a small condensing lens which brings the rays of light to a point on the surface of the photograph. The pencil of light is, of course, absorbed by the photograph to an extent depending on the density of the image at that point. The transmitted light is reflected by a small prism, P, upon the photo-sensitive cell S. It is thus seen that as the photograph is rotated spirally, different consecutive portions of it intercept the light beam, and so control the intensity of the illumination falling upon the cell S. In at least one modern system a photographic *print* is wrapped round the cylinder, and a spot of light is focused upon the surface at an angle of 45 deg. The *reflected* light is cast upon the sensitive cell.

Inasmuch as the conductivity of the cell S varies in proportion to the intensity of the illumination, the current from a battery flowing through the cell to the telephone or telegraph line will be controlled in strength in accordance with the tones of the picture at each instant.

Turning now to the right-hand side of the diagram (fig. 1) we see how this continuous current of varying amplitude is used to build up the facsimile image: MM are the poles of an electromagnet, the poles being tunnelled so as to allow rays of light from a lamp N_2 to pass through them, and through the diaphragm H on to a sensitive photographic film wrapped round the cylinder D. Between the poles of the magnet is suspended a flat silver or phosphor-bronze "string" WW through which the received current is passed. The magnet with its metal strip is thus a simple form of Einthoven, or string, galvanometer. The flat string is, of course, arranged in conjunction with a suitable optical system, so that when in the position of rest it just

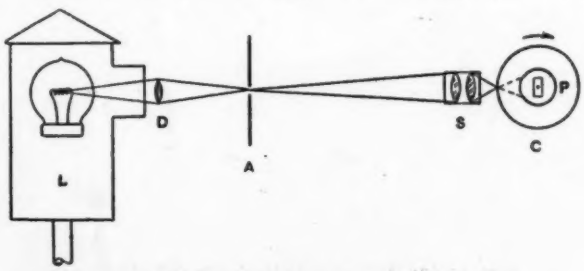


Fig. 2.— Transmitter Lamp and Lens System.

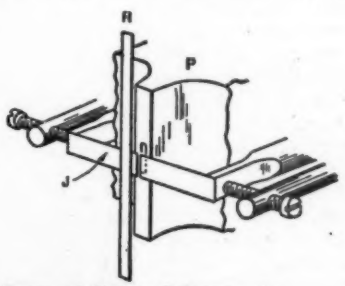


Fig. 3.—Form of String Galvanometer.

* See Elec. Rev., July 24th, 1925, and June 4th, 1926.

completely intercepts the light, so that no light falls upon the photographic film. It is well known that within certain limits, the lateral shift of the galvanometer string bears a linear relationship to the current strength. As therefore the received current changes in strength in accordance with the density of the image

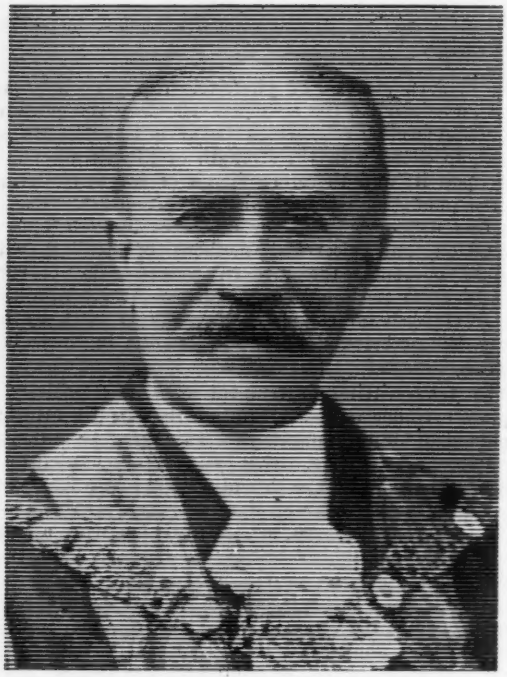


Fig. 4.—Reproduction of Received Image.

being dealt with in the transmitter at any instant, so the intensity of the light falling on the film changes correspondingly. When the transmission is completed and the film developed, a replica of the original photograph is obtained.

In Korn's actual apparatus an ingenious method was used of overcoming the well-known inertia and lag of the selenium cell by using it in one arm of a Wheatstone bridge, in the opposite arm of which was a second cell (simultaneously illuminated) of opposite characteristics. This considerably improved the performance of the transmitter, but it was never found possible to deal with anything more complicated than a very simple portrait. We may turn our attention now from this early method to the remarkably satisfactory system of the Bell Telephone Laboratories Inc., and see just how recent electrical advances have paved the way for its completion.

The transmitter comprises a lamp house L, light from the lamp of which is focused by a lens system as shown in fig. 2, so that the rays cross on the periphery of a glass cylinder C, to which the transparent photograph is attached; P represents a photo-electric cell consisting of a vacuum tube in which the cathode is an alkali metal, such as potassium. Under illumination, the alkali metal gives off electrons, so that when the two electrodes are connected through an external circuit, current flows. This current is directly proportional to the intensity of the illumination.

On the receiving instrument a form of string galvanometer is used which is termed a light valve, and consists essentially of a narrow ribbon-like conductor, (R in fig. 3) lying in a magnetic field in such a position as to cover entirely the small aperture shown in J; P is the tapered magnet pole. The receiving lamp house, light valve and drum are displaced as already shown in fig. 2. The current from the transmitter is passed through the metallic strip, which thus controls the amount of light falling upon the sensitive photographic film attached to the receiving drum.

It may be mentioned that the photo-electric currents are very weak in comparison with ordinary telephone currents. The current from the cell is therefore first amplified by valves, and is then impressed upon a vacuum tube modulator jointly with a carrier current, the latter having a frequency of about 1,300 cycles per second.

The movement of the light valve has the effect of varying the width of the line of light which is being traced upon the photographic film, so that if one examines a small portion of the received image when greatly magnified, it is seen to be made up of light and dark parts which are composed of fine and wide lines respectively, see fig. 4.

The wireless system devised by Captain Ranger which is frequently used for transmissions between New York and London, depends also upon a photo-electric cell in the transmitter. The current from the cell undergoes several stages of valve amplification, and then operates an ordinary pattern of telegraph relay. Dark parts of the picture are represented by groups of rapidly repeated signals always of the same duration and closely packed, while lighter parts are represented by lesser numbers of signals widely spaced. These signals are tranmitted over an ordinary telegraph line to the wireless transmitting station, and the received wireless signals are once again converted into telegraphic signals, and are transmitted over a Post Office line to London, where they are used to operate a miniature

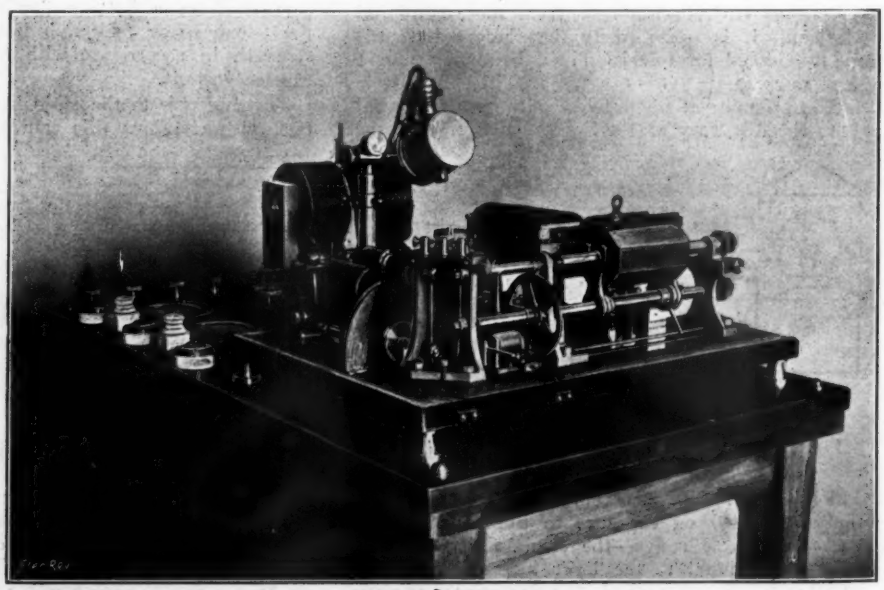


Fig. 5.—The Belin Telestereograph.

electric pen under which is a sheet of paper attached to a synchronously-revolving drum. The ink is of a waxy nature, kept liquid by means of a tiny electric heater in the pen pot. Each time a signal is received, the pen strikes the surface of the paper and leaves a

dot which instantly dries—and as already indicated, groups of dots close together build up a dark part of the image, while spaced-out dots produce a half-tone or a high-light according to the spacing.

Yet another method of reception from a photo-electric cell transmitter is employed in the Karolus-Telefunken system now being used by certain London newspapers. One of the chief points of this system is that a photographic print is transmitted instead of a transparency. The photo-electric cell is of an annular type, so that the beam of light from the illuminating lamp can be focused through the cell on to the surface of the image. The light is reflected back from the image upon the ring-shaped cell, and the intensity of the reflected rays is, of course, controlled by the density of the image. It is probable that the writer first employed this method of using light reflected from a paper print, in the "Telectograph" as used for wireless transmission.

In the Karolus-Telefunken system the mechanical light valve above described is replaced by an optical relay based on the well-known Kerr effect. This relay comprises a condenser, the electrodes of which are separated by a transparent dielectric, such as carbon disulphide. The containing cell is placed between two crossed Nicol prisms; advantage is taken of the double refraction of polarised light. The light is polarised by the first Nicol at an angle of 45 deg. with the direction of the field in the cell, and is divided into two rays, of which the speed of propagation is different under the influence of the dielectric. When the two components of the emergent ray fall upon the second Nicol, through having a difference of phase depending on the pressure applied, their luminous resultant will be affected, and the amount of light reaching the photographic film is in this way controlled at each instant by the strength of current received from the transmitter, *i.e.*, by the brightness of the photograph.

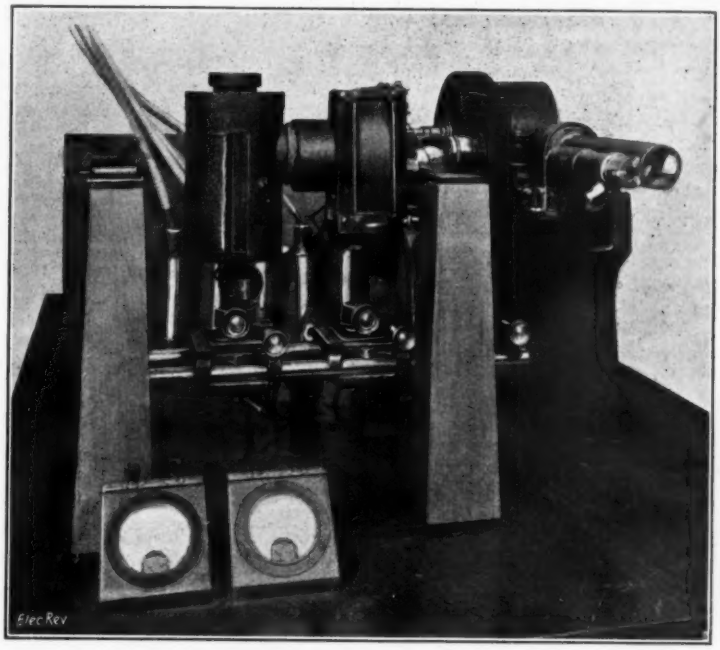
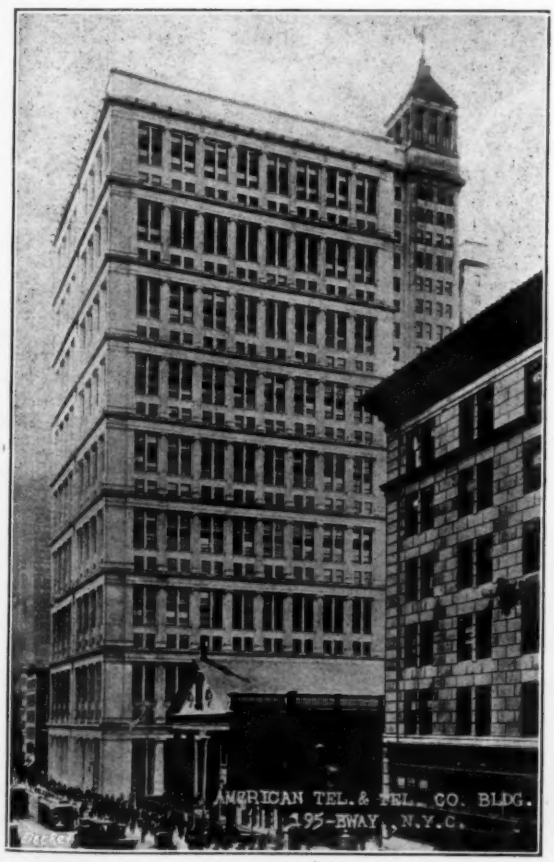
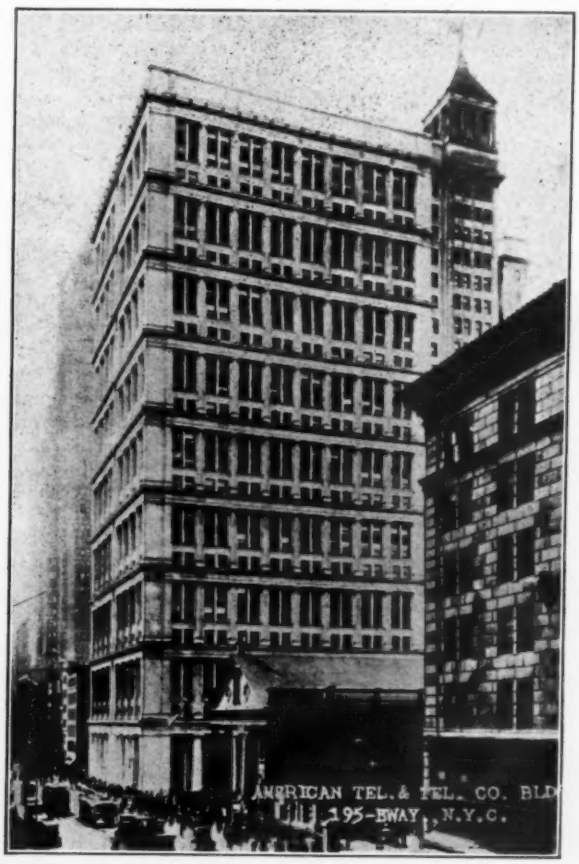


Fig. 6.—Bell Receiving Apparatus.





Figs. 7 and 8.—A Reproduction of the Original (left) and Received Copy (right) of Photograph Telegraphed by the Bell System.

So far we have seen that all methods of transmitting pictures make use of the controlling effects of the different tones of a photograph upon the illumination falling upon a photo-sensitive cell. There are, however, purely mechanical methods, such as those of Korn, Belin, and the writer.

A well-known method of making photographic prints is the carbon process. In this process a thick gelatin film, impregnated with some dye, is sensitised with bichromate of potash, printed under a negative, and then washed in hot water. The effect of the exposure is to render the gelatin insoluble to different depths according to the tone of the picture. The printed "carbon tissue" is transferred to a support, and when developed the print appears in very high relief, the dark parts of the image being most raised, the lighter parts least raised, and intermediate tones in intermediate relief. Belin employs such a print, and mounts it on a metal cylinder which revolves beneath a stylus pressing firmly upon the surface. As the cylinder revolves, the hills and dales of the relief picture press against the stylus, which is attached to the tympanum of a highly-sensitive microphone, and the microphonic current is passed into the line. At the receiving station the current is passed into a mirror galvanometer, actually a Blondel oscillograph of the oil-damped type, and the angular movements of the mirror are made to control the amount of light (collected through a graduated screen), which is concentrated upon a revolving photographic film.

This system can, of course, be applied to writing in relief, and Belin has, for this reason, been able to solve the problem of sending telegrams in facsimile in Chinese and Japanese characters. A service of picture telegraphy for ordinary messages has, in fact, been recently installed between Peking and Mukden. Fig. 5 shows Belin's Telestereograph.

The other method of transmission, originally tried by Korn in 1908, and used by the writer for over two years in daily transmissions between Manchester, Paris, and London with the Telectograph, involves the use of a half-tone photograph printed in fish glue or albumen on metal foil. Newspaper reproductions consist of tiny dots, which are of a bigger diameter in the dark parts of the image, narrowing down to a mere point in the "highlights." These half-tone reproductions were originally made in the form of single lines, and line pictures were used for the purpose of transmission. An example is seen in fig. 4. Such an image printed in fish glue, sensitised with bichromate of potash, upon thin copper sheet, is attached to the metal drum of the transmitter. As it revolves, a metal stylus traces over the surface, and as fish glue is an insulating material, the flow of current to the line is interrupted by the lines of the image for periods proportional to their width. An intermittent telegraph current is thus transmitted, which at the receiving end is fed into an exactly similar instrument with a platinum needle tracing its path over a piece of chemically-prepared paper. Each time current flows, a chemical mark is made on the paper, and a facsimile image is thus recorded. The Thorne-Baker Telectograph can be readily adapted to any wireless circuit, and provides an ideal means of wireless transmission. Broadcasting experiments are being carried out on the Continent under the auspices of Mr. O. Fulton, who, with Messrs. W. Watson & Sons, has been responsible for considerable improvements in the method of synchronisation.

So far we have discussed transmitters and receivers without reference to the highly important matter of synchronisation. Needless to say, the drums of transmitter and receiver must rotate in absolute synchronism, and it is the mechanical perfection of this part of the programme which has been the real secret of the commercial success of modern systems, as compared with those of the pioneers of twenty years ago.

All attempts at keeping the transmitting and receiving drums in step by means of carefully controlled springs or electric motors have proved inadequate. The method of synchronising the two instruments that has met with complete success is that involving the use of phonic wheels or impulse motors which are controlled by electrically-operated tuning forks. One tuning fork or tuned reed controls the two motors, the motor of the receiver being operated by impulses sent from the transmitter.

In the Bell system the image-forming signals are sent on a high-frequency carrier of about 1,300 cycles per second, as already stated, while the synchronising impulses are sent on a lower-frequency carrier current of 400 cycles. The two frequencies, provided by valve oscillators, are kept separate by an appropriate system of filters. Fig. 6 shows the Bell receiving apparatus; figs. 7 and 8 are, respectively, a reproduction of the original and a received copy of a photograph telegraphed by the Bell system; the illustrations show the loss in detail.

Some idea of the figure of merit required in the performance of the synchronous motors may be gathered from the fact that at least one hundred signals are transmitted per linear inch of the photograph. With a drum 2 in. in diameter, and therefore a picture about 6 in. in length, this would mean 600 signals per revolution. The two cylinders would have to be kept in step at least within 1/1,200 of a revolution, or in phase within about a quarter of a degree. The time of transmission by the Bell system of a picture 7 × 5 in. is seven minutes.

Before dismissing the subject of photo-telegraphy, some mention should be made of the Bart-Lane system, which is in frequent use by the *Daily Mirror*, and is an eminently practical system of picture transmission. In this process the different-sized dots in a half-tone photo-mechanical image are made by the use of an ingenious selecting device to operate a punch which perforates a paper tape. This tape can then be run through an ordinary telegraph instrument of the standard pattern, and the system thus provides a means of submarine transmission.

The received message is translated again into a perforated tape, which in turn operates a highly ingenious exposing device, which forms a photographic image on sensitised film or paper.

Television.

It is interesting to note in connection with the statement which the B.B.C. has made (see Elec. Rev., July 20th, 1928, p. 112) with regard to the broadcasting of pictures, that a similar attitude has been adopted in Germany by the Reichs-Rundfunk-Gesellschaft. While taking the liveliest interest in the various inventions for picture transmission, and watching with sympathy the experience gained in every quarter, the R.R.G. does not feel that the moment has arrived to support preferentially any one of the systems, says *World-Radio*. It is believed that unless and until special wavelengths can be set aside for the transmission of pictures, any existing method would hardly justify results. On the other hand, there is the danger that, if alterations in a transmitting system were introduced, apparatus purchased by listeners might become obsolete. The R.R.G. will continue to collaborate with the Reichspost and inventors in the further development of the technical side of picture transmission and reception.

In America also a like opinion seems to be held; for instance, to quote *Popular Science Monthly* . . . . "newspapers and public speakers have talked of television as an accomplished fact. It is really hard to convince the half-informed person that television, regardless of what to-morrow may bring, to-day is nothing more or less than a laboratory plaything, a fertile field for experimentation . . . fortune awaits the fortunate individual who can take television as it is and make it what it ought to be." See also Elec. Rev., July 20th, 1928, pp. 96-8.

A Modern Industrial High-Pressure Laboratory.

An Account of the Equipment Used for Testing Insulating Materials.

By PROF. A. IMHOF, Winterthur, Consulting Engineer to Micafil, Ltd.

IN the last few years a large number of high-pressure works laboratories have come into existence in rapid succession, to an extent which has never been known before. The reason given for this is the large transmissions of power which are necessary at very high voltages. It has been proved that both porcelain and paper are specially suitable for high-tension insulations, but a continuous and careful supervision of the quality and the construction is necessary until the process of manufacture is completed. Very high voltages have often been attained, but more for the sake of advertisement than for actual measurement. Generally, cable manufacturers are very conservative in their choice of voltage, but as a direct result of the extensive improvements in measuring instruments that have taken place, great progress has been made.

A high-tension works laboratory to-day must serve two purposes—the insulators must be expeditiously and yet thoroughly examined with regard to their quality and size, so that they are suitable for manufacture; also accurate research is absolutely necessary in connection with the improvement of quality and the study of convenient dimensions and construction details. The latest laboratories utilise many of the principles arrived at in earlier high-tension laboratories. The test room must be spacious, otherwise the results will be unfavourably affected by the field strength on the surface of the test piece. The test apparatus should be placed along the walls whenever possible, so that there is more space for testing purposes. The apparatus should be so arranged that no long test pressure leads are required. Good ventilation, and illumination by adjustable reflectors, must be provided.

In recent years it has become more and more evident that simple pressure tests alone are not nearly sufficient, but that a combination of the pressure test and an accurate measurement of the dielectric losses is more capable of producing information regarding the suitability of paper-composition insulation. Pressure tests include not only short-duration tests at considerably increased voltages, but also the control of the pressure distribution along the surface of the insulation; and a heating arrangement is required for measuring the losses at higher temperatures.

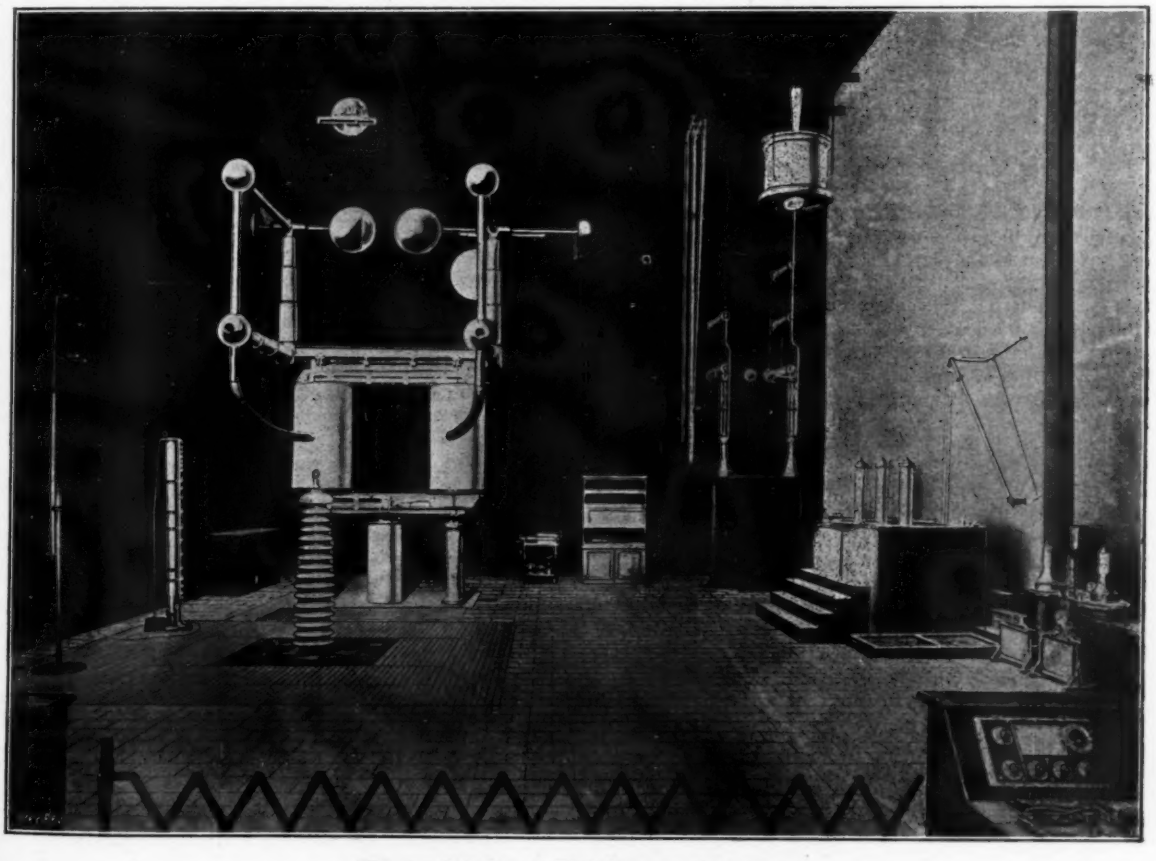


Fig. 1.—Interior of High-Pressure Test Room.

The following is a description of one of the latest and largest industrial test laboratories, noteworthy for the fact that it embodies the foregoing principles and possesses a good equipment of measuring instruments. The laboratory was erected on the occasion of an important extension of the workshops of Micafil, Ltd. (Switzerland), and is used primarily for testing insulating bushings and paper-composition insulations of all

kinds. The choice of the maximum test pressure and of the measuring instruments was influenced chiefly by the fact that condenser bushings are usually made up to 220 kV rated pressure, corresponding to an American test pressure of 500 kV (export). A maximum pressure of 700 kV was thus decided upon. Contrary to usual practice, value was placed on a high output of the

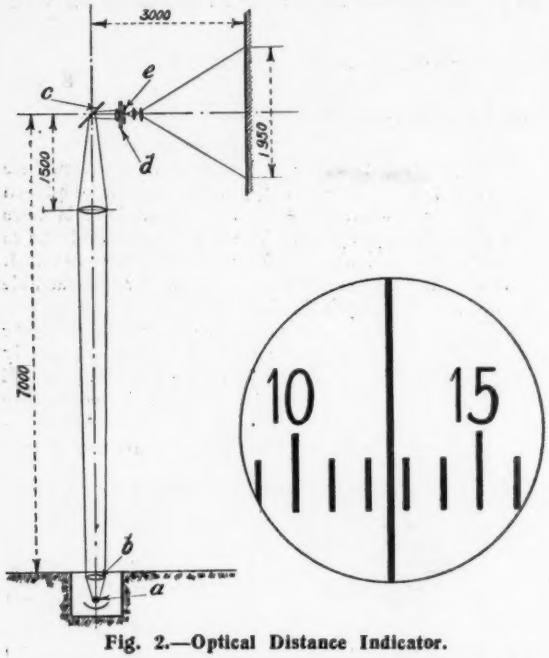


Fig. 2.—Optical Distance Indicator.

pressure supply in order that errors due to insufficient power supply need not be feared. While, for example, the test room of the German porcelain factory in Freiburg is partitioned off from the transformer room, in this case that practice has been departed from, as it is absolutely incorrect to have longer and more complicated extra-high-pressure leads than are absolutely necessary. Leads should not be taken through walls unnecessarily. This principle has been fully considered here.

The test room, fig. 1, has a floor 12 × 16 m. and a height of 10.5 m. There is only one window; the walls are painted black and the floor is paved with wood. A runway of channel section is fixed to the ceiling for easy transport of the test piece. A high door opens into a manufacturing room, whilst another door leading to the open air generally remains closed.

There is an oil-immersed transformer of 100 kV to earth, for testing small objects, with a direct mounted spark gap, and in addition a second oil-immersed transformer up to 250 kV, likewise with direct mounted ball spark gap, both made by Brown, Boveri & Co. There is a transformer with two tappings having the considerable capacity of 250 kVA for large test pressures. The insulating transformer gives a pressure up to 350 kV; it is an oil-immersed transformer sunk into a pit 3 m. deep, and excites the end-transformer standing on paper composition insulation; the laminations of the end transformer are under a potential of 350 kV when the transformer is supplying 700 kV. Contrary to the usual oil-immersed transformer practice, only the high-tension windings are immersed in oil and the low-tension windings and laminations are in air. Both of the hollow cylindrical oil-chambers surrounding the vertical cores consist of Mi-B cylinders which are flanged to the metal base in order to be oil tight. The test-pressure terminals, one of which is earthed in the usual manner, pass through the outer walls of these chambers; in this way the usual high-tension bushing is dispensed with. Fig. 1 gives a general view.* Both of the large transformers are regulated through a control desk; the voltmeter, with four ranges of measurement, has a scale illuminated from the rear. The spark gaps are remotely controlled from these desks. Both spark gaps are directly mounted on the transformers. The protective resistances consist of Silit rods. The diameter of the ball for the 250-kV spark gap is 25 cm., and for the 700-kV spark gap 75 cm. The distance indicator for the smaller gap is of the dial type, illuminated from the rear; the pointer mechanism of this distance dial is coupled to the spindle, which moves one of the balls. The larger spark gap has a novel optical distance measurer, proposed by the author, fig. 2. A small searchlight on the floor of the test room throws a vertical beam against a plane mirror inclined at 45 deg. to the vertical (this stands under the high tension), and from there through a travelling glass scale on the movable ball, and thence through a lens on to the wall opposite to the control desk. The magnification of the scale is so chosen that differences of 1/10 mm. can be easily distinguished. With this system no errors in measuring can be caused. The earthed ball is divided into two parts in such a manner that the insulated segment can be used as a counter electrode to the ball under voltage, and the spark gap used as a standard air condenser for measuring losses at the highest voltages.

The test room contains two complete sets of instruments for measuring dielectric losses. One method is that devised by Barbagelata & Emanueli, and it has been developed by the makers, Trüb, Täuber & Cie., Zürich, into a very ingenious form for technical measurements. The excitation of one of the zero voltmeter coils occurs on the high-tension side, by a current passing through a high water-resistance (fig. 3), which can be considered as a purely ohmic resistance; the current in the moving coil is 90 deg. out of phase with the current of the water resistance, as long as the test object shows no loss of capacity, and the wattmeter shows zero reading. With a test object which is not free from losses, the angle of loss is compensated by a variable reactance. The wattmeter is used as a zero reading wattmeter, and the angle of loss, after being compensated, can be read on a scale. Angles of loss between 0 deg. and 10 deg. can be measured when the exciting current is between 60 and 70 mA (water resistance). Fig. 3 is a diagram of the connections.

The water resistance also fulfils the desired purpose

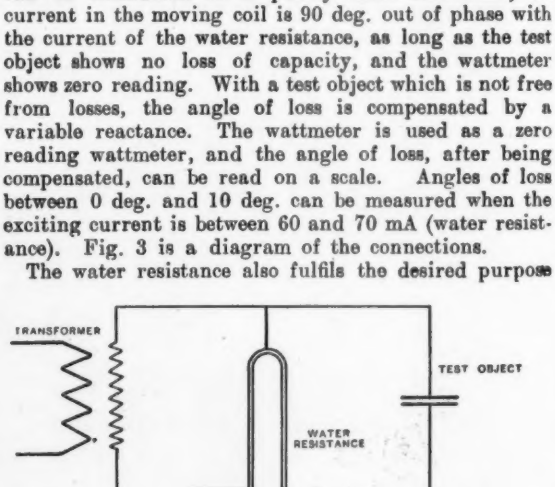


Fig. 3.—Diagram of Connections for Measuring Dielectric Losses.

of a potential divider, when testing the surface potential gradient of insulators. A fine wire ring is wound round the insulator in various places and conducted across a neon tube to the water resistance, which is connected in parallel with the insulator. The water resistance is adjusted until the neon lamp becomes extinguished, thus indicating that the position of equal

* For a detailed description see the "Brown, Boveri Review," 1927, No. 4, pp. 105-109.

potential has been reached. It should be noticed that the water resistance can be used up to pressures of 300 kV, despite the compact design of the plant. The height of a water resistance of the usual pattern was too great, and therefore high-pressure rubber tubing

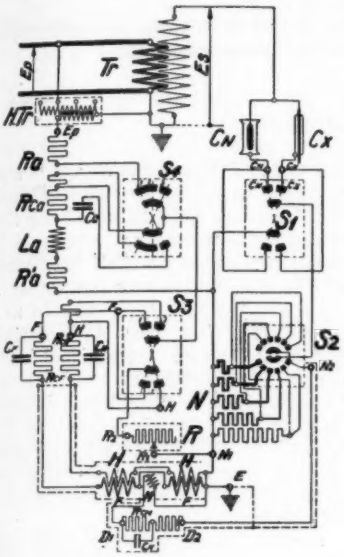


Fig. 4.

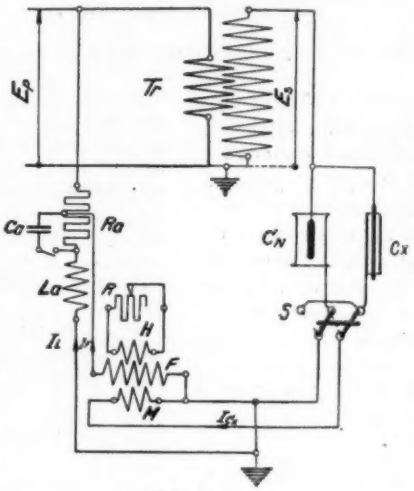


Fig. 5.

Apparatus for Measuring Dielectric Loss.

wound in a helix on a paper compound cylinder (Wirth) is used. The self inductance of this is negligible. The water flows through the tube, to the upper end of which the high tension is connected; then through a nozzle which breaks up the stream into drops, so that the portion between the h.t. terminal and the earth, which is not used for measurement, is of infinite resistance.

The second measuring set (figs. 4 and 5) also supplied by Trüb, Täuber & Co., and built to the suggestions of Dr. Täuber-Gretler, makes use of a highly sensitive, electro-dynamic wattmeter with two fixed windings and a moving coil hung on a bronze strip. A screened air condenser serves as a standard of comparison. One of the fixed coils F, fig. 5, is connected through impedances R_a, L_a, C_a, to the terminals of the low-tension winding of the test transformer T_r, while the other coil is short-circuited through a variable non-inductive resistance R. The field winding F and auxiliary winding H are closely inductively coupled. The moving coil M is connected in series with an air condenser C_N and the test object C_x through a selective change-over switch S. By means of the self-induction coil L_a and the condenser C_a, the exact capacities of which need not be known, the angle of error in the testing transformer T_r can, if necessary, be over-compensated according to the load and excitation, to such an extent that the field current I_F in the electro-dynamometer, which is 180 electrical degrees out of phase, leads on the secondary voltage E_S. Measurement of the input of the test object and the determination of the angle of loss is arrived at by altering the resistance R. A current I_H is induced in the auxiliary winding H by the current I_F and lags on it by 90 deg. The resulting magnetic fluxes ϕ_F and ϕ_H combine together to form a flux ϕ_{FH} which lags on ϕ_F. If the current I_{Cn} flows through the moving coil, the deflection, which is the first case can only be observed through phase alteration of currents I_F and E_S by means of the large steps of L_a and C_a, can be brought exactly to zero by the resistance R. The angle of error of the testing transformer is then compensated. On changing-over the switch S the current I_{Cx} flows through the moving coil. I_{Cx} lags on I_{Cn} by the angle of loss E. A deflection a_{Cx} is observed on the wattmeter; this is a measure of the power absorbed by the test object. If the deflection a_{Cx} disappears due to a decrease in the resistance R, the angle of error can be calculated from the adjusted value of R and the constant of the instrument. In order to select the input for C_x it is necessary to know the ratio of transformation for each load. Dr. Täuber has pointed out that the reaction of the current flowing through the auxiliary coil, on the impedance of the field circuit, is negligible. Shunts are required for the moving coil when testing large objects.

It is clear from fig. 4, which shows the complete plan of the connections, that the coefficients of self-induction of all the instrument windings are compensated by condensers with suitable shunts. The sensitiveness of the measuring is proportional to the charging current of the air condenser and the supply pressure. A small auxiliary transformer HTr with a sufficient number of tappings on the primary side is provided so that it is possible to retain this sensitiveness even with very small supply pressures. The range of measurement is 2 deg. 12′, and is sufficient for all practical purposes.

A steam-heated oil tank is used when testing small objects in hot oil. An oil tank 3 m. deep and 3 m. in diameter is provided for testing larger objects, especially large insulating bushings, which are built as standard up to 220 V; it is completely sunk into the floor and holds about 22,000 litres of transformer oil. To remove objects which have fallen in, there is a wooden grating which can be drawn up. The top of the tank can be shut off in such a manner that insulators, placed in the middle, can be subjected to a heavy water spray from all sides (fig. 6), as an increasing number of outdoor bush-

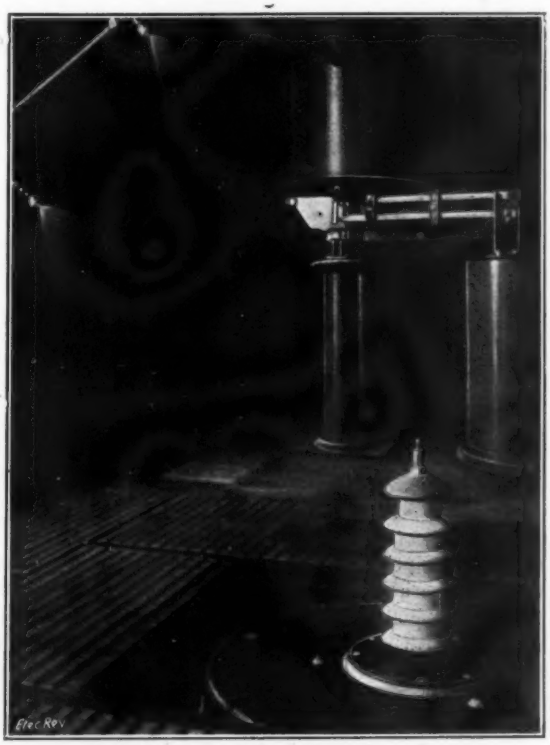


Fig. 6.—Testing Insulating Bushings under Water Spray.

ings made of paper compound with porcelain covering are now being used.

Tests are undertaken in a smaller laboratory on the raw material and the mechanical, thermal and hygroscopic properties of finished insulators.

Thermal Resistance of Cables.

An explanation of the greatly improved thermal dissipative capacity claimed for an "intersheath" cable, as compared with a single-core cable, together with other advantages possessed by the former.

By MAJOR A. M. TAYLOR, M.I.E.E., M.Am.I.E.E.

IT is believed that the vast majority of engineers, even among those who have given some attention to the matter, are unable to see where any *material* gain comes in, from the thermal dissipative point of view, by the employment of intersheaths.

They are willing to concede that the employment of intersheaths gives a "small" advantage, in the way of increased voltage permissible with a cable of a given limiting diameter (though even here, judging by recent correspondence in the technical Press, the point is hardly appreciated); but they consider that any material claims, whether for voltage or for thermal dissipation, for the intersheath cable are in either case more or less fanciful.

The author of this article has therefore set himself the task of attempting to show, as the result of a very careful investigation between the two classes of cable, starting with equal diameters, equal potential gradients, and equal thermal drops inside the cable. that the thermal resistance of a single-core cable—such as, for instance, the 132,000-volt cable now in operation at Newark, U.S.A.—is of the order of 70 per cent. greater in amount than that of the intersheath cable.

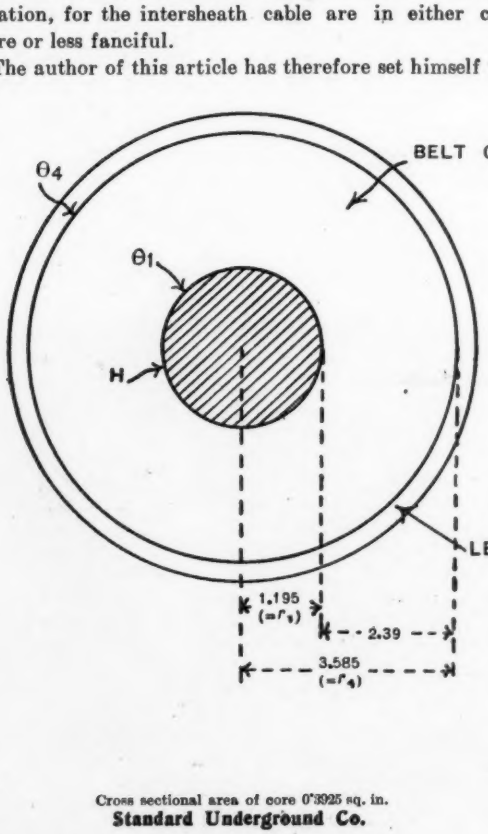
It will be conceded that, if this can be substantiated, there is much more in the intersheath cable than at first appears.

If to this is added that approximately 45 per cent. more voltage can be taken up by the intersheath cable, representing (cet. par.) 45 per cent. more power transmitted, the superiority is still further enhanced.

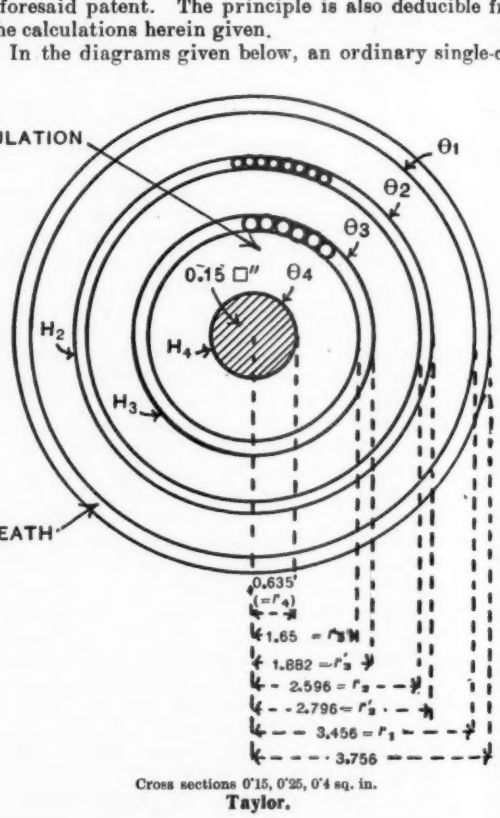
Though outside the scope of the present article it may be remarked that if, on the top of the above advantages, it can be shown that there is a gain of something like 95 per cent., conferred by improved arrangements in getting rid of the heat in the ground itself (and other developments), it will be understood why the author is able to claim that the cost has now been reduced to a point where it is even less than with OVERHEAD CABLES provided that the power transmitted is big enough to justify the use of these underground cables.

The principle at issue, in the comparison between intersheaths and non-intersheaths, is given in the author's British Patent No. 264,196 (American Patent No. 1,639,473), and those interested are referred to the aforesaid patent. The principle is also deducible from the calculations herein given.

In the diagrams given below, an ordinary single-core cable (such as that now being tested at Newark, New Jersey) and an intersheath cable, as recommended by the author, are shown side by side, and dimensions are given (in centimetres).



Cross sectional area of core 0·3925 sq. in.
Standard Underground Co.



Cross sections 0·15, 0·25, 0·4 sq. in.
Taylor.

The calculations will be confined to a simple statement of the process of evaluating the thermal resistance (per centimetre), and it will be noticed that the conclusion arrived at, taking for the value of κ (*i.e.*, the thermal resistivity) the figure of 550, is that the thermal resistance s comes out at 96 thermal ohms per cm.

It will also be seen how, obtaining this figure in another way, it is equivalent to the "drop" across the insulation divided by the heat liberated per second in the copper, and it is on this basis that the "equivalent" thermal resistance for the intersheath cable is defined.

Single-Core Cable.

Standard Underground Company's cable taken as a sample:—

Heat loss $\left\{ \begin{array}{l} H = I^2R = (49\ )^2 \times 0.000000808 \\ \quad = 0.199 \text{ joule per cm.} \end{array} \right.$

$\log (r_4/r_1) \times 0.199 = 0.477 \times 0.199 = 0.095.$

and $(550/2\pi) \times 2.302 \times \log (r_4/r_1) \times 0.199 = \theta_1 - \theta_4.$

Cable section = 500,000 circular mils, = 0.3925 sq. inch.

s (thermal res. per cm length) = $\theta_1 - \theta_4$ (*in deg. Cent.*) ÷ H (joules).

$s_1 = (K/2\pi) \times 2.302 \times \log (r_4/r_1)$ .... (Proc. I.E.E. May 1923, page 512.)

Single-core cable.

$s \times H = \theta_1 - \theta_4 = H \times (K/2\pi) \times 2.302 \times \log r_4/r_1$

$s = (K/2\pi) \times 2.302 \times \log r_4/r_1 = 96.0$ thermal ohms per cm.

H (for the single-core cable) = I^2R = (see above) = 0.199 joule per cm.

$s_1 = 19/0.199 = 96.0$ thermal ohms.

Intersheath Cable.

Considering now the "intersheath" cable and treating this in a similar way, it will be seen that the sum of the thermal drops over the three belts of insulation, viz., 6.58° C., 5.375° C., 5.840° C. (or a total of 17.79° C.) divided by the sum of the three denominators given, namely, 0.0789 joule, 0.1118 joule, 0.1242 joule (or a total of 0.3149 joule), gives a thermal resistance of 56.5 thermal ohms, against the 96 thermal ohms obtained for the single-core cable.

Intersheath Cable.—For 16.915 deg. rise and 139,800 kW transmitted,

$s = (\theta_4 - \theta_1)/\Sigma H = [(\theta_4 - \theta_3) + (\theta_3 - \theta_2) + (\theta_2 - \theta_1)] \div (H_4 + H_3 + H_2)$

$= (6.58 + 5.375 + 5.840)/(0.0789 + 0.1118 + 0.1242)$

$= 17.79/0.3149 = 56.5$ thermal ohms.

In order to bring the temperature drop up to 19 deg. C. we must increase the output to $139,800 \times \sqrt{(19/17.79)} = 144,000$ kW.

At 144,000 kW (at the same voltage of transmission) the current in each intersheath is increased in the ratio of

144,000/139,800 = 1.032

the losses ... ... $(144,000)^2/(139,800)^2 = 1.065$

the temperature drops ... $(144,000)^2/(139,800)^2 = 1.065$

the joules (H) ... ... $(144,000)^2/(139,800)^2 = 1.065$

Hence $s_{(3\text{-core})} = (\theta_4 - \theta_1)/\Sigma H = (17.79 \times 1.065)/(0.3149 \times 1.065) = 18.95/0.336 = 56.5$ thermal ohms per cm.

But the corresponding thermal resistance (s) for the *single-core* cable as shown above = 96.0 thermal ohms.

Now $\frac{s_{(1\text{-core})}}{s_{(3\text{-core})}} = \frac{96.0}{56.5} = \frac{1.700}{1.000}$ A disadvantage of 70 % more thermal resistance.

The earlier calculations having been got out on the basis of transmitting only 139,800 kW (three-phase system) and not the 144,000 kW required to give a thermal drop of 19 deg. C. (required for comparison with the single-core cable, which is worked out for this thermal drop), the factors composing the numerator and denominator of the fraction giving the value of s have to be increased, in each case, by the multiplier 1.065 (see figures above), which, of course, still gives the same value of the thermal resistance (as might have been expected), but which now reduces both the calculations to the same basis of temperature drop. (It will be noticed that the output of the single-core cable works out at 90,800 kW. This, however, is not permissible on account of the "drop" in the ground and the proximity of two other cables.)

For the sake of those who wish to follow the matter further, some further particulars are given, relating to the details of the calculation of the thermal drop over each successive section of the belts of insulation of the intersheath cable.

Intersheath Cable (details).

$\theta_4 - \theta_3 = 2.302 \times (550/6.28) \times 0.0327^* = 6.58$ deg. C.

$\theta_3 - \theta_2 = \quad " \quad " \quad \times 0.02665^* = 5.375$ deg. C.

$\theta_2 - \theta_1 = \quad " \quad " \quad \times 0.02885^* = 5.840$ deg. C.

0.08880.

* These figures are obtained from the equations given below.

(per phase)

110,000 V × 196 A × 3φ × 0.8 = 51,700 kW.

75,000 × 297 × 3φ × 0.8 = 53,500 "

37,300 × 396 × 3φ × 0.8 = 34,600 "

139,800 kW. @ 190,000 V between phases.

Heat losses for 139,800 kW (at 190,000 V) are (hot):—

(I^2R) in innermost core per cm. = $(196)^2 \times 0.00000211$ = 0.0789 joule.

" Intermediate " " " = $(297)^2 \times .000001266$ = 0.1118 "

" Outermost " " " $(396)^2 \times 0.000000791$ = 0.1242 "

Total = 0.3149 "

(H_4) × log r_3/r_4 = $0.0789^J \times 0.414 = 0.0327$

$(H_4 + H_3)$ × log r_2/r_3 = $0.1907^J \times 0.140 = 0.02665$

$(H_4 + H_3 + H_2)$ × log r_1/r_2 = $0.3149^J \times 0.092 = 0.02895$

Total = 0.08880

The result of the investigations as given above is that, taking these two cables, which are of almost identical diameter, voltage gradient, and thermal drop, the *thermal resistance of the single-core cable is* 1.70 *times that of the intersheath cable.*

There is some considerable probability that, if this large value of the gain in thermal dissipative capacity has been at all appreciated, it has been immediately discounted by the assumption that, other things being equal, there can be no gain in, say, halving the internal temperature drop if the temperature drop *in the ground* cannot also be halved. It is in this direction that the author's later efforts have mainly been directed; but to describe how this has been effected is beyond the scope of the present article.

A Model Demonstration Farm.

A well-planned and completely equipped electrified farm is no doubt the best means of demonstrating the value of electric service in farm operations. The Middle West Division of the National Electric Light Association decided that such a plan of education would be worth while, but that the number of farms necessary to carry on such a programme in the Middle West was too large to make the plan practical. So instead of arranging for farms to which the farmers would come, they built a miniature model farm, fully equipped, which could be taken to many hundred thousand farmers. Complete plans and specifications were drawn up, and the "plant" was built on a scale of half an inch to one foot.

Every detail of an actual farm is carried out in miniature. Electric service is supplied by a 6,600-volt, single-phase line, and the transformer is located on a pole in the yard. The farmhouse is fully equipped with modern lighting, radio, convenience outlets, an electrical kitchen with electric range, refrigerator, electric sink, and ventilating fan. In the basement the laundry is equipped with electric washing machine, flat-iron, and ironer, and hot water is supplied through an electric heater and an electrically-driven water system. The yard is lighted with a two-bracket fixture, and additional bracket lamps are mounted over doorways where needed. For the farm the following electrical equipment is installed: motor-driven milking machine, cream separator, steriliser, portable elevator, chore motor, motor-driven repair shop, electrically-heated incubator, brooder, and oat sprouter. This model farm is being exhibited under the auspices of the Middle West Division, N.E.L.A., rural electric service committee.—*Electrical World.*

Photographs for Advertising Purposes.

How to Make, File, and Store Technical Photographs.

By W. McWILLIAM.

IN my own branch of industry, that of electrical engineering, a larger and more varied selection of photographic records is perhaps necessary than in any other sphere of commercial activity.

The problem presented is peculiar in many respects. First of all, the records must be good ones: to this end all the latest developments in chemical and optical science must be studied and made use of so far as they are relevant.

Then there is the *personnel* of the establishment to be considered. Industrial operations are of necessity carried through in a consecutive and orderly manner, so that when a photographic record of any detail of manufacture is required, the exposure must be made just when the particular point to be illustrated has been reached.

The undertaking with which I am connected grew up from very small beginnings. We had, in the first instance, only an old half-plate camera and three leaky dark slides. As the plates used were quite slow, "ordinary" speed in fact, it was possible under happy conditions to get a good result with it. The general shakiness of the apparatus, however, militated against the production of anything like a first-class negative of a difficult subject.

I took the plates home to develop, and printed the negatives out of the office window next morning, giving the office boy a penny each for toning and fixing the prints in his spare time. This, of course, was in the good old leisurely days when there was not very much to do and plenty of time to do it in.

Since then things have grown rather more hectic, but I still take photographs in the intervals of my publicity and technical work, and I still take home the plates to develop.

The reason for this somewhat unusual procedure is as follows: I have previously mentioned that when the necessity arises for a photograph to be taken, it has to be done at once, or else time is lost in the factory owing to the job being left standing for the exposure to be made. This precludes the possibility of a trade operator being called in, owing to the time taken by him to present himself after the call has been made.

The method we now adopt for dealing with the developed plates is one which works extremely well. Once a week, or oftener in busy times, all new negatives are collected and sent in a padded box to a leading firm of trade printers in London. Immediately on receipt of them, a serial number is neatly painted by a ticket writer for a trifling charge on the corner of every negative, and one print is made from each.

These single prints are returned to us, the negatives being retained by the printers and stored by them on our behalf. The single prints are filed by us in slip-in albums, which are titled on the back according to the subject-matter of the prints they contain.

A separate numerical index of each negative is, of course, kept, but the albums themselves constitute a most valuable subject record of all photographs taken. Thus, for instance, if at any time during an interview with a client the subject of regulating transformers comes up, the album containing the photographs of that subject is instantly produced without the necessity of making a hurried search through some index or other in order to select suitable illustrations.

Cross-indexing may also be indulged in to any extent, as extra register prints may be filed in two or more albums bearing separate and distinctive titles.

Prints from some negatives are, of course, required in large quantities for sending away. We keep quite a big stock of those most in demand, which stock is kept up to a predetermined quantity by a weekly order.

The stock prints are kept in folders in numerical order, so that the estimating engineers, for instance, can, by first consulting the albums, obtain suitable photographs to accompany any sort of tender they may happen to be making.

A final word or two about the technical details of engineering photography may not be out of place. As it is obvious that such photographs must be of permanent value, any sort of celluloid film base for the negatives should be ruled out entirely. The percentage of breakages of glass plates is very small indeed compared with the damage done by finger marking on flexible films when they are constantly being handled by trade printers.

As a small additional refinement, I prefer the best pan-chromatic plates, backed to prevent the halation otherwise met with on interior work.

Half-plate and whole-plate sizes are found to be the most convenient in use, the latter being preferred for heavy or important work. For half-plate service, the Sanderson hand camera, being completely self-contained, is as handy a set as can be imagined. For the whole-plate instrument, however, it is just as well to go to some firm that specialises in technical cameras, or else one may be landed with a rickety contraption which is a source of anxiety all the time it is in action.

The lenses to be used also require some thought. Much of the work will have to be done in confined situations, so that at least two lenses for each size of camera will be necessary. One lens should be of ordinary focus, say 8 in. for a half-plate and 11 in. for whole-plate, and the other, termed a "wide angle," should be of 5 in. focus for half-plates and 7 in. for whole-plates.

The design of the best lens for technical work should be carefully considered. On no account should one be persuaded to purchase any of those complicated lens designs, coming chiefly from abroad, which are composed of several separate glasses, each of which has two surfaces in contact with air. Every internal air space in a lens constitutes a separate source of weakness, and tends very often to cause the light waves forming the image to scatter as they pass from glass to air, and air to glass, with a consequent loss of definition on the print.

The old-fashioned lens known as the "Rapid Rectilinear" is as good as any for technical work, composed as it is of two elements only. It has the additional advantage of being extremely moderate in cost. Better lenses of the same sort can, of course, be obtained, which will work, if required, at a larger aperture. I doubt very much, however, whether the extra cost of such things is worth incurring, especially as they are very weighty, and also because for good work on a whole-plate scale, exposure by large apertures is not often possible on account of the slight depth of focus available.

One thing, in conclusion, is absolutely necessary—it costs next to nothing, but it scores every time—that is the use of an efficient lens hood of some sort.

It can be made out of anything handy, such as cardboard or belting leather, but the difference it makes to the results as shown by the finished photographs is quite worth a little trouble in making it and remembering to use it always.

Forecasting Raw Material Prices.

A Consideration of the Factors Underlying and Explaining Price Movements.

By A. W. WILLSMORE.

In the course of a lifetime of purchasing, a buyer for any large concern usually develops a very marked and reliable market sense. He will tell you that he gets a "hunch" of impending movements in prices, and makes his purchases on the strength of that "hunch," backed up by a scrappy reading of trade papers. Now, it is obvious that if the manufacturing side of a firm is to progress smoothly, a proper stock of raw materials must always be available. But it does not seem to be equally appreciated that, unless the financial success of the concern is to be impaired, those raw materials must be purchased at the right prices. With any decided fluctuations in price levels, the buyer who has had the foresight to lay in a stock of materials in advance of a rise in prices puts his firm in a very strong position compared with its rivals who may have been caught short and forced to purchase at peak prices. In view of this fact, it is somewhat surprising that so little attention has been paid to the science of price forecasting, which involves a systematic study of statistical tendencies as a means of prevising the effect of probable future changes in production, consumption, and stocks on market prices.

Before attempting to forecast the probable changes in the price of a commodity, it is necessary to understand the factors which enter into and explain fluctuations in prices. The price of a commodity is its value defined in terms of a standard commodity (or commodities) used as a monetary unit. Obviously, then, changes in the value of the money commodity will result in changes in all the commodity prices based on that standard. Thus, when a country inflates its currency by issuing money in excess of the legitimate needs of trade and commerce, there automatically follows a rise in prices, measured in terms of the debased currency, although the intrinsic value of the various commodities may not have shown any change. Conversely, in this country when our return to gold involved us in pushing up the value of the pound sterling, we experienced a period of falling prices from which we are only just recovering. But although the possibility of changes in the value of the monetary unit must always be borne in mind when forecasting prices, this factor merely explains the cause of a general movement in prices, and we must seek elsewhere the reason why the price of one commodity may be tending steeply upwards at the same time that the price of others is falling sharply.

The fluctuations in the price of individual commodities are the result of changes in the relationship between supply and demand, and this fact is summed up by economists in the statement that prices are determined by the "Law of Supply and Demand." This "law," however, like most economic laws, is not so much a hard and fast rule as a statement of tendencies subject to certain very important qualifications.

Broadly speaking, in the long run the price of a commodity is governed by the cost of production. If a producer of copper, for instance, finds that the price he is getting for his metal is not sufficient to pay his expenses, he may continue operations for a while in the hope that prices will pick up, but unless they show some sign of improvement he will soon be forced out of production. When he ceases production he automatically decreases the supply of metal on the market, and the resultant increased competition among consumers will tend to lead to higher prices and so tempt the producer back into the market. All producers do not work under identical conditions, and the market price depends on the cost of production to the least efficient firm necessary to meet the demand. In the long run, therefore, the price is determined by the cost of production to the firm working on the margin between profitable and non-profitable working, and in any forecast of prices it is necessary to give careful consideration to this marginal producer. The discovery of fresh seams of ore which are comparatively easily worked, the development of new processes, new methods for recovery of scrap material, all these factors determine the least efficient working necessary to meet demand and so have an important effect on prices.

Turning to the effect of demand on price, an increase in the demand for a commodity would tend to result in increased production, but only if the market price were sufficient to induce fresh producers to open up, or existing producers to extend production. Therefore, in itself, an increase in demand would normally involve a rise in prices, but more often than not the steady growth in demand is accompanied by improvements in production which enable lower prices to be charged. This fact must be considered when weighing up the probable effect of increased demand on price. The key to the question lies to a great extent in the effect the change has on production, and whether production is carried on under conditions of increasing or decreasing returns. Production of a commodity is subject to increasing returns when an increase in production means a lower unit cost (either through mass-production methods or the economies of large-scale production), while under decreasing returns each increase in production means a corresponding increase in the unit cost. The condition of production will have a very marked effect on prices, but it should not be forgotten that a commodity can, at different stages of production, be subject to both rules, so that, although only to a certain point, each increase in production may mean a lower unit cost; when that stage has been reached each addition to output implies a high average price. It must also be remembered that if production is subject to increasing returns and the demand falls off, the price will tend to go up because of the higher unit cost for the lower output. In addition, consideration should be given to whether the commodity is a prime product or a by-product. Leather, for instance, is a by-product from the production of meat, and the supply of pelts is determined, not by the demand for leather, but by the demand for meat.

We have seen that over any considerable period of time the price of a commodity is determined by the cost of production to the least efficient firm. But this price is not fixed automatically, and it may be of interest to consider what happens when one of the more favourably-placed producers is out in his estimate of what the economic price should be. The possibility that he would ask too low a price and so tend to drive less efficient firms out of the business is rather remote, and the increase in demand would soon lead to a readjustment. But if he charged too high a price, the increase in selling price would enable more mines to be brought into production, and the increase in supplies would tend to restore prices to their proper level. In addition, if the price of a commodity were fixed at an uneconomic level, there would be a tendency for consumers to adopt cheaper substitutes wherever possible, with a consequent decrease in demand. It must be appreciated, however, that the demand for all commodities is not of the same nature. Demand may be elastic or rigid. If the commodity in question is a necessity, a change in

price would not have much effect on the amount demanded. For instance, it is doubtful whether much more bread would be consumed even if its price fell by one half, although it is possible that a very large increase in price might possibly lead to the substitution of, say, potatoes for bread to a certain extent. But if the commodity is a luxury, demand may be very susceptible to changes in price, while the demand for other commodities may be elastic within certain prices and rigid beyond those prices.

All the qualifications previously laid down imply the existence of a reasonable degree of competition. It must be appreciated, therefore, that the state of affairs is changed when a group of producers gets together to form a monopoly. Examples of monopolies or semi-monoplies are very frequent in the base-metals business, and in taking the long view it is necessary to consider what is likely to be the policy of the men behind the ring. They may force up prices by creating an artificial shortage, but the presence of any suitable substitutes will tend to prevent them from exploiting the public. A large increase in price will always lead to the use of alternatives wherever this is possible, and a case in point is the considerable research with a view to finding satisfactory substitutes for tin which followed the recent sensational rise in its price to £300 per ton. The producers endeavoured to peg the price at £300 per ton, but the underlying economic forces were too strong for them, and the price has since fallen to little over £200. In fact, it is doubtful whether any monopolistic body would be able to maintain an uneconomic price level for any considerable time.

We have thus considered the factors behind long-term movements in prices, but these factors do not account for the day-to-day and week-to-week movements. These are the result of disturbances in the balance between production and consumption. If consumption increases sharply in comparison with production, there follows a decline in stocks, and, irrespective of the cost of production, prices will rise rapidly and will remain on a high level until increased supplies brought about by the rise in prices come on to the market and restore the balance. The length and extent of the disturbance will depend upon whether production is considerably or only slightly affected by changes in price, and by the necessary lag between an increase in price and a consequent increase in production. Changes in fashion and seasonal disturbances are also price-determining factors, but they do not seriously affect a dealer in metals.

In putting a theoretical price knowledge into practice charts should be prepared showing price, production, consumption and stocks over as long a period as possible, and the relationship between the four should be carefully studied. Although the various tendencies are the same for all commodities, similar changes in production will not always have the same quantitive effect on price, and a study of the characteristics of the individual commodity is necessary. Every change in price over the past should be taken into consideration and its cause found out. Having done this, the forecaster will be in a good position to weigh up current data and forecast the effect of anticipated changes in the relevant factors. He will not obtain a mathematical price formula capable of rigid application to practice, but he will obtain a means whereby he can exercise his market sense to the best advantage. In short, the science of price forecasting does not aim at supplanting, but assisting the purchaser, and the experience of several large manufacturing concerns shows that in this respect it does a great deal towards eliminating errors due to mis-judgment.

The Teaching of Engineering Mathematics.

The scarcity of suitably trained teachers indicates that the status of this particular branch of the profession needs to be raised.

By AN ENGINEERING LECTURER.

THE quality of mathematical instruction available in different parts of the country is of a curiously mixed nature. In some places it is exceptionally good and efficient; in others, to say the least, it is rather patchy.

One of the weak points of mathematical training is lack of thoroughness when teaching algebra. It is not always obvious at the immediate moment, but months later, when the student is just nicely getting into the calculus, it shows up with vivid clearness. Time and time again have I seen students baffled by lack of algebraic knowledge when attempting to use the calculus. Long ago as a student I learned the bitter lesson myself; as a teacher I have noted time after time the same weakness. Well do I remember my mathematical lecturer saying to the class, after the algebraic part of a calculus problem had beaten us all, "It's algebra you men don't know, not the calculus." He never uttered a truer sentence.

To a student thoroughly grounded in algebra, the calculus is by no means difficult; to one who has only a half-hearted acquaintance with the older branch of mathematics, the calculus becomes a fearful and terrifying thing. But the real stumbling block, which very often the student cannot discern at the time, is not the calculus but algebra.

The remedy, of course, is obvious; more attention must be given to algebra in the earlier stages of a man's training, signs of which I have been glad to note in various parts of the country.

Another point which deserves attention is the shortage of efficient teachers of higher mathematics. When a man has reached degree standard in mathematics he is only on the fringe of a vast field of knowledge, to which, I am afraid, very few find easy entry. In order to guide post-graduate men clearly and carefully through this fascinating but difficult realm, teachers of the very highest type are necessary. They should be men who have specialised in mathematics, and have obtained some such distinction as a Doctorate of Science. In addition, they should be lecturers with a great understanding of the psychology of the advanced student, and the capability to lucidly explain and impart difficult and complicated mathematical theories. Such teachers are few and far between; rarer still are the men who, having such high qualifications, are prepared to spend their lives simply teaching mathematics. Usually they desire to devote their time to other work, very often original research. Such a state of affairs is serious and an effort should be made to remedy it. The remuneration of mathematical professors should in all cases be at least as high as that of similar posts in other branches of science, whilst the importance of high-class mathematical teaching should be continually emphasised. In short, everything possible should be done which will raise the status of this particular branch of the profession.

A further defect in present-day mathematical teaching, of special interest to engineers, is the lack of correlation between pure calculus and calculus applied to engineering problems. The extent of this defect, of course, varies with each college and lecturer, and it is not intended to imply that it exists in equal degree all over the country. If the practical application of the calculus is neglected, its value to the engineer becomes very small indeed. How many engineers, for example, actually use the calculus in their daily work? The percentage is small. And yet the calculus is undoubtedly one of the most powerful methods there is of tackling certain types of questions.

The problem once again is the problem of suitably trained lecturers and teachers. How can a man, however brilliant from a pure-mathematical point of view, teach the use of the calculus in the engineering profession, unless he himself has so used and applied it? And, as mentioned above, the man who has reached this stage does not usually feel inclined to transfer his activities to teaching. The problem is not an easy one to solve, but it does seem desirable that mathematical lecturers for engineering departments and faculties should have had high-class practical engineering experience at some part of their career.

One very attractive method of developing this phase of the subject might be by introducing a little of the history of mathematics, showing the need for methods of solving certain problems, and how the calculus was developed and can be used to obtain the required solutions. Historical mathematics is practically never introduced into mathematical lectures in these days of overcrowded curricula, yet it throws great light on the why and wherefore of mathematical processes, and a little judicious blending of the history of mathematical development would go a long way towards a better appreciation of the practical value of the calculus by engineering students.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The Electrical Market in Greece.

It is anticipated that there will be a continually improving opening for electrical material in Greece consequent upon the construction of the large power plant to serve Athens and the Piræus. The concession for the supply of energy is in the hands of a British company, but distribution will be effected by a French concern, the "Société de Distribution d'Electricité" (offices 9, rue Paparighopoulo, Athens). The distribution works include an underground and aerial cable network. The 110-V d.c. supply will be changed to 220 V a.c. At the present time 220 V d.c. is being distributed to certain customers. In the provinces certain areas will be supplied by the Hellenic Electricity Company, the head offices of which are in the Rue Aristide, Athens. In most cases only provisional concessions have yet been obtained. Although electricity is being used at present in several Greek towns, it is not employed in the country districts. As far as the railways are concerned electrification is not under consideration, except for the new line between Athens and Kiphassia, which only extends for about eight miles. The work in connection with the electrical installation is being undertaken by the Greek firm Diamantopoulo, with the help of German engineers. It will not be entirely completed for three or four years yet. There are no concerns manufacturing electrical material in Greece. In the past power companies have not encouraged the use of electricity in the ordinary household for heating, cooking, &c., as their output has not been large enough to do more than provide for the lighting, tramways, and industrial loads. Fans are much used. There is an opening in Athens for an inexpensive type that would work at either 110 or 220 volts for use both before and after the voltage-change takes place. Small, low-power motors for sewing machines are widely used in the many small workrooms and dressmaking establishments. In addition to the Singer firm there are German firms—such as Grohmann, Nitmann and Gritzner—which are supplying quantities of these. Neon tubes for outdoor signs are at present unknown. Electric drills are little used. Cables and wires find a market in Greece that is estimated to average annually 60,000,000 drachmæ, with a weight of about 6,500,000 kg. Amongst household apparatus the "Frigidaire" refrigerator is perhaps the object of the most intensive salesmanship by advertising propaganda. Refrigerators should certainly interest the Greek buying public as there is an urgent need for the use of such appliances to preserve food in the household during a considerable part of the year. Only a few factories are at present using motors to supply power for their machinery. Those that do so are chiefly spinning and weaving concerns. For accumulators there is only a small demand. Germany is supplying some fixed batteries; other kinds come from the United States and France. For about a year now Greece has been in the throes of a commercial and economic depression, and the spending capacity of the inhabitants has been curtailed accordingly.

Engineers and Unemployment.

Some interesting comments appear in the *Journal* of the Amalgamated Engineering Union (August) on the unemployment question. Quoting from the Labour correspondent of a leading newspaper, who is described as well known for his ability to deal with the serious subject, it is said that the mining figures account for relatively only a small part of the total increase in unemployment during the past three months, and the fact that unemployment is increased in certain industries, in conjunction with the heavy fall in railway revenue, suggests that the accumulative effect of the enormous reduction in the purchasing power in the principal industrial centres is now being felt.

Commenting on the measures adopted by the Government, the *Journal* says: "We have no intention of raising any objection to their action in moving unemployed persons to places where work is obtainable. That, however, ought not to be their full quota towards a remedy. The question is becoming international in character, and some day it will have to be faced from that point of view. The solution suggested of more and cheaper production might be countered by a full and impartial inquiryy as to whether the time has not arrived when a shorter working week should be recommended, not only for this, but also for other countries."

Our Foreign Electrical Trade.

The following were the values of imports and exports of electrical goods and machinery during July, 1928:—

	July, 1928.	Inc. or dec. as compared with July, 1927.	7 months, 1928, Inc. or dec.
Imports—	£	£	£
Electrical goods and apparatus	335,354	+ 23,792	+ 280,520
Machinery	1,460,690	+ 58,679	+ 429,054
(Inc. electrical machinery)	150,251	+ 15,513	+ 71,074
Exports—			
Electrical goods and apparatus	864,363	− 13,738	− 48,019
Machinery	4,567,231	+781,090	+4,471,856
(Inc. electrical machinery)	546,617	+ 3,205	+ 72,655
Re-exports—			
Electrical goods and apparatus	12,150	− 52	+ 9,982
Machinery	146,834	+ 17,109	+ 115,185
(Inc. electrical machinery)	11,327	+ 5,695	+ 32,789

German Aluminium for Russia.

It is reported to be probable that the difficulties of financing the proposed aluminium transaction between Germany and Russia may have been overcome. The delivery of the quantity

by the United Aluminium Works Company on credit, which, in the first place, is to consist of 1,200 tons, does not come into question for the company, but it is probable that two German metal merchant firms will undertake to finance the transaction.

Bankruptcy Proceedings.

William Jawett, electric lamp dealer, 58, Bedford Street, E.—The above debtor was brought to the Court on July 25th on the petition of the British Thomson-Houston Co., Ltd., creditors for £70, and on the 8th inst. the statutory first meeting of the creditors was held at the London Bankruptcy Court. It appeared from the proceedings that the debtor was a Polish Jew, and came to this country in 1913. He was interned from August, 1914, to August, 1917, and was then released on parole. He was interested in lamps of various kinds, and in 1925 started trading from his private address, 88, Bedford Street, as a dealer in electric lamps with a capital of £20. He kept the business going till 1927, just making a bare living. Amongst others, he traded in gasfilled lamps of a type the patent of which was held by the petitioning creditors; and the lamps he was selling were of foreign manufacture. He was not aware that the lamps were an infringement of the petitioning creditors' patents till June, 1927, when the petitioning creditors obtained an injunction against him. They then proceeded against him for costs, and he offered them £50 in settlement, conditionally on their taking no further proceedings against him for damages. This they declined to accept, and filed the petition against him. He attributed his present position to his liabilities for costs. He estimated his liabilities at £160 and his assets to produce £74. There was no offer, and the matter was left with the Official Receiver.

W. Barraclough, wireless dealer, &c., 45, Owston Road, Carcroft, Doncaster.—First meeting August 16th, at the Official Receiver's Offices, Figtree Lane, Sheffield. Public examination October 4th, at the County Court Hall, Sheffield.

O. C. Lay (Home Wireless Installation Co.), accumulator specialist, 2c & 2d, High Street, Wandsworth.—First meeting August 16th, at 29, Russell Square, W.C. Public examination October 11th, at the Court House, Wandsworth.

J. Littler, electrical and radio engineer, 9, Hoghton Street, Southport.—Trustee, Mr. A. T. Eaves, 47, Mosley Street, Manchester, appointed August 4th.

J. G. Smith Cunnington (separate estate), trading with H. P. Allison as Laing, Wharton & Cunnington, electrical engineers and contractors, 7, Great Newport Street, W.—Supplemental dividend of 10s. 7d. in the £, payable at Carey Street, W.C.

G. Dodd, wireless dealer, &c., The Arches, and Radcliffe Road, Crimble, Golcar.—First and final dividend of 1s. 10d. in the £, payable at the Official Receiver's Office, 12, Duke Street, Bradford.

A. J. Wells, electrical engineer, lately in partnership with W. Bashford as Wells & Co., electrical engineers, 52, Princess Street, Luton.—First and final dividend of 5s. 5d. in the £, payable at the Official Receiver's Office, The Parade, Northampton.

Company Liquidations.

The Betax Manufacturing Co., Ltd., 486, Oxford Street, London, W.1, and Gray's Inn Road, London, W.C.2, dealers in electromedical appliances.—The statutory meeting of creditors of the above was held recently at Chiswell House, Finsbury Pavement, E.C. The liquidator reported that the ranking liabilities were £3,474, all of which were due to unsecured creditors. The assets were estimated to realise £4,135, from which had to be deducted £32 for preferential claims and £2,000 due on debentures. The net assets, therefore, were £2,103, or a deficiency, so far as the creditors were concerned, of £1,370. The company was registered in December, 1924, with a nominal capital of £5,000 to take over an existing business. With the exception of £100, all the issued shares were allotted to the vendor or his nominees in payment of the assets acquired by the company. When the company was formed there were liabilities of £1,200, but the assets included cash in hand £372, book debts £707, stock £2,890, and office furniture £44. During the first 12 months the turnover of the company was £8,063, with a gross profit of £4,679 and a net loss of £1,600. In 1926, the turnover fell to £7,450, but the net loss was reduced to £190. Last year the turnover still further declined to £6,163, and there was a gross profit of £3,120, but a net loss of rather more than £1,000 was incurred. The debentures were issued in 1925 for cash, and a receiver had been appointed. A resolution was passed confirming the voluntary liquidation of the company with a committee of three of the principal creditors.

Hungerford & District Electricity Supply Co., Ltd.—A meeting of creditors was held on August 15th, at 7, Duke Street, Adelphi, W.C.

Dissolutions of Partnership.

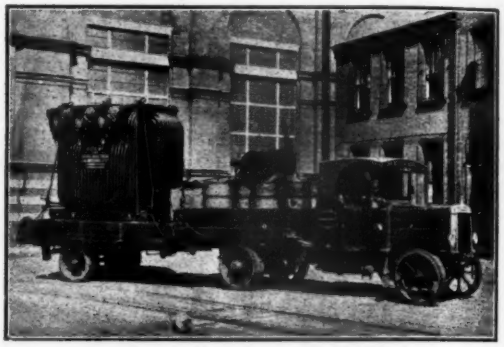
Lindsay & Ward, electrical and mechanical engineers, 90, Pilgrim Street, Newcastle-on-Tyne.—Mr. J. D. Lindsay and Mr. G. Ward have dissolved partnership. Mr. Lindsay will attend to debts and continue the business under the same style.

Quantock Electric Co., electric and automobile engineers, Quantock Road, Bridgwater.—Mr. B. G. Hardingham and Mr. E. J. Board have dissolved partnership. Mr. Board will attend to debts and continue the business under the same style.

Universal Radio College, wireless telegraphy tutors, 60, Station Street, Birmingham.—Mr. W. F. Elliott and Mr. H. E. Crowe have dissolved partnership. Mr. Elliott will attend to debts and continue the business.

A Transformer in Transit.

The accompanying illustration shows a 2,500-kVA three-phase 31,040/10,480-volt transformer, manufactured by the Brush Electrical Engineering Co., Ltd., leaving the works at Loughborough for delivery to the Yorkshire Electric Power Co. For convenience of transport the oil was conveyed in drums, and the total weight of the load exceeded 20 tons.



2,500-kVA Transformer En Route.

German Trade with South Africa.

German trade deputations are now in South Africa negotiating trade treaties with the Union, under which they seek favoured-nation treatment. Press reports show that German goods imported into South Africa last year amounted to £4,500,000, while produce exported to Germany was £4,250,000.

Unemployment.

The total number of persons on the registers of employment exchanges in Great Britain on July 30th was 1,305,000, representing an increase of 22,066 on the figure for the previous week, and 185,172 over the number for the corresponding week of last year.

New Catalogues and Lists.

Messrs. A. C. Cossor, Ltd., Cossor House, Highbury Grove, N.5.—Illustrated leaflet advertising Cossor "Daylight Blue" automobile lamps Priced.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, 43-47, Parker Street, Kingsway, W.C.2.—Bulletin No. 99, an illustrated and priced catalogue describing, in addition to standard physio-therapy apparatus, equipment representing the latest advances in electro-medical science.

Messrs. H. W. Sullivan, Ltd., Leo Street, Peckham, S.E.15.—Three priced and illustrated catalogues describing, respectively, the makers' a.c. measuring apparatus, d.c. measuring apparatus, and fixed and variable laboratory air condensers.

Messrs. Siemens Bros. & Co., Ltd., Woolwich.—Catalogue 641, illustrating and describing "Siemens" batteries. Priced.

The Bright Star Battery Co., Hoboken, N.J., U.S.A.—Booklet containing information concerning "Bright Star" batteries in use in the American Navy.

Messrs. Ringsdorff Carbons (England), Ltd., 66, Victoria Street, S.W.1.—Leaflets illustrating "Ringsdorff" carbon brushes and brush holders, and one giving information on the use of the brushes.

Messrs. Hathorn, Davey & Co., Ltd., Sun Foundry, Dewsbury Road, Leeds.—Catalogue illustrating and describing the "Stereophagus" pump.

Messrs. Brookhirst Switchgear, Ltd., Northgate Works, Chester.—Leaflet No. 255, giving particulars of two new catalogues (12 and 13), dealing with d.c. motor control gear, which are in preparation.

Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.—Pamphlets relating to the offer of cable stands for displaying or stocking automobile and radio cables.

Messrs. Ateliers de Constructions Electriques de Charleroi, Route de Philippeville, Charleroi.—List of motors and dynamos in stock on August 1st.

Messrs. Campbell & Isherwood, Ltd., Raleigh Street, Bootle, Liverpool.—List E.P.T.8, illustrating and describing portable electric grinders.

Messrs. Mather & Platt, Ltd., Park Works, Manchester.—A booklet, "Centrifugal Pumps in the Oil Industry." This is a short treatise on the subject, and contains much hitherto unpublished information required by the field and refinery engineer.

Messrs. Radio Communication Co., Ltd., 34-35, Norfolk Street, W.C.2.—List P/628, illustrated description of marine radio equipment.

THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD.—Circular No. 1440/9-1, a reprint from "The Metropolitan-Vickers Gazette" of Mr. J. R. Finniecome's paper on "The Flexibility of Plain Pipes."

MESSRS. SULZER BROS., 31, Bedford Square, London, W.C.1. —Catalogue L, No. 31e/VI, 1928, describing Sulzer Diesel engines; very well illustrated and produced.

French Railway Electrification.

A further step in connection with the electrification of the French railways has been taken by the conclusion of an agreement between the French Minister of Public Works and the Minister of Finance on the one hand, and the Chemin de Fer du Midi on the other, according to which funds are made available for an extension of the work of electrical conversion of this Southern Railway. About 620 miles has already been transformed to electrical working, and now a further 682 miles is to undergo the change. For the supply of the rolling stock the railway company is stated to have entered into a contract with the Siemens-Schuckert Works and the Constructions Electriques de France of Paris. In the first place, 100 locomotives and 15 motor coaches are to be supplied for a direct-current pressure of 1,500 volts and a speed of 58 miles per hour for the passenger locomotives, and 48 miles for the goods trains. It is stated that the German deliveries are to be made on reparation account, and that the General Agent for Reparations has given his consent to the allocation of the order.

The German Brown-Boveri Company is also reported to have received from the same railway company an order for the electrical equipment for 24 convertor stations (60,000-volt polyphase current to 1,500 volts direct current). The stations will be equipped partly with rectifiers and partly with rotary convertors. The order is to be carried out by the German company in conjunction with the Compagnie Electro-Mecanique of Paris and the Compagnie Française Thomson-Houston, the German share being included on account of reparations.

Trade Announcements.

Messrs. GEORGE GREEN & CO. have erected a new factory for the production of "Gee Gee" electric heating appliances, and in future all communications should be addressed to them at the Gee Gee Works, Chapel Road, West Norwood, S.E.27. Telephone No.: "Streatham 8727."

Messrs. J. H. PEASE (SOUTHEND), LTD., dealers in electric lamps, fittings, &c., announce that their business at 23, Queen's Road, Southend-on-Sea, is shortly being closed down.

The ELECTRIC HEATING CO. OF CROYDON has appointed the Holland House Electrical Co., Ltd., of Glasgow, as its agent for Scotland; Mr. H. Riddiough, of Bradford, for the West Riding of Yorkshire; and Mr. W. E. Betts, of Bristol, for Gloucestershire and other counties.

The CAMPBELL GAS ENGINE CO., LTD., has been purchased by Messrs. Geo. Cohen, Sons & Co., of London, who early this year bought up a Letchworth steel company. Mr. G. Levy, a director of Messrs. Cohen, states that if his company decides to carry on the Campbell Co., many important changes will be made in its organisation to effect economies.

THE EQUIPMENT & ENGINEERING CO., of 2 & 3, Norfolk Street, Strand, W.C., announces that the partnership which has existed since 1908 has been transferred to a private limited company, the Equipment & Engineering Co., Ltd. Messrs. E. E. Daglish and W. L. Lorkin, partners, are joint managing directors, and Messrs. W. T. Robson and A. Vickers, who have been associated with the firm for many years, have been appointed directors, as has also Mr. P. V. Fearon (late of the Brush Electrical Engineering Co., Ltd.). The new company will attend to the debts of the firm.

Catalogues Wanted.

Messrs. LEONARD TOOMER & CO., of 54, Lower Thames Street, E.C.3, ask for copies of price lists of lamps, fittings, fires, radio accessories, &c.

New Swiss Company.

A new company has been formed at Peseux, with the title La Société des Fours Electriques Borel, to manufacture electric furnaces.

New French Company.

A new company has been formed in Strasburg, with a capital of three million francs, and the title La Société de Transport d'Energie Electrique d'Alsace et de l'Est.

Irish Free State Electrical Imports.

The imports of electrical goods, excluding machinery, into the Irish Free State during June last amounted to £35,068, bringing up the total for the first six months of the year to £213,673, as compared with £185,855 in the corresponding period of 1927.

Social Event.

British Insulated Cables, Ltd., entertained 70 members of the staff and employés of the Warrington Electricity Department on the occasion of their annual picnic at Helsby. The two principal recreations of the visitors were fishing and bowling competitions, facilities for which were provided by the company. Mr. F. V. L. Mathias (borough electrical engineer) presented the prizes to the winners.

Polish Telephone Extensions.

The Polish Distant Cable Construction Company has been formed in Warsaw for the extension of the underground telephone cable system in Poland. The Polish branch of the German Siemens group will participate in the undertaking, together with the International Telegraph and Telephone Corporation and three Polish cable works.

Book Notices.

"Rating of Machinery and Plant in England and Wales: Position in July, 1928." By John Scott Henderson, B.Sc., Lond. Pp. 43. London: The Argus Press, Ltd. Price 5s. net.—The law of rating of machinery and plant was put on an entirely different basis by the Rating and Valuation Act of 1925, and will be further altered by the rating relief proposals before Parliament. This book, therefore, which deals with the new law and the special procedure set up to decide disputes as to what is ratable machinery, will be welcomed by users of machinery and rating officials and surveyors. The book makes it clear that the Government proposals do not by any means amount to the de-rating of machinery, and that opposition of various kinds may have to be surmounted before machinery escapes any rating at all. Difficulties which are foreseen in connection with the electricity undertakings, the transmission of power and electric motors are outlined in Chapter 2—"The Provisions of Sec. 24 of the Rating and Valuation Act, 1925, and the Machinery and Plant (Valuation for Rating) Order, 1927. The book also contains a list of all Statutory Orders relating to machinery, and a list of the referees appointed to arbitrate in disputes.

"N.E.M.A. Handbook of Apparatus Standards." 17th edition, 1928. Pp. 348; illustrated. Published by the National Electrical Manufacturers' Association, 420, Lexington Avenue, New York City. Price, $3, post paid.—This book, which represents the modern accepted practice in the United States, contains the standard practices recommended or adopted by the Association in connection with the manufacture, test and performance of practically all industrial electrical equipment.

Publications of the National Electric Light Association, 420, Lexington Avenue, New York City.—Serial report of the Prime Movers Committee; "Boilers, Superheaters and Economisers" ($1.00). Serial report of the Hydraulic Power Committee; "Mechanical Reliability of Hydro-electric Units —1926" (25 cents).

The *Journal* of the Municipal College of Technology, Manchester, Vol. 13, 1927. Published by the Education Committee. —This volume contains an account of tests made in the Research Department. The Metropolitan-Vickers Electrical Co., Ltd., on "Eddy current loss in the armature conductors of electrical machines due to the main flux."

A New International Finance Group.

As previously mentioned, an electrical financing group has been formed in Amsterdam under the title of the Maatschappij tot Financiering van Electrische Ondernemingen, with a capital of 10,030,000 fl. Besides Dutch interests, the names of other participants given are those of Speyer & Co. of New York, the Chase Securities Corporation of New York, the Dresden Bank, the Darmstadt and National Bank and the Electricity Company (late Lahmeyer & Company), together with the Hambros Bank of London. The new company will chiefly devote its activity to the provision of credits for the electrical undertakings closely associated with the above-mentioned interests as the founders of the company.

The Timber Market.

Our Timber Trade Correspondent reports that the consumption of European softwoods for building and general construction purposes has shown a satisfactory increase over the past month, but stocks comparatively being fairly large, spot prices for the lower grades have not firmed up yet compared with shippers' ideas for future business, although for the better qualities values are more firm. Forward buying is lagging very much, importers not yet being confident that shippers' rates will hold; on the other hand, European exporters seem determined to hold out for their rates, and are diminishing their output as much as possible to offset the smaller United Kingdom demand this year. In the hard and fancy woods market better-class logs are scarce, and values very firm, but inferior logs are in very limited request. American lumber is still too heavily stocked, with prices still on the weak side, and consequently other sawn hardwoods are affected. Imports of American oak, ash, satin walnut, and other woods, however, are likely to decline, which should have the effect of strengthening that section of the wood market.

Prices of Raw Materials.

Messrs. James Forster & Co., reporting on August 10th, stated that consumption of lead remained pretty constant, but showed no signs of increasing, the firm tone prevailing in the market being due to the prospect of short supplies this month. Indications point to the continuance of the present firm conditions, with a prospect of a further advance in price in the near future.

Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, August 14th:—No change in copper prices.

Messrs. James & Shakespeare report, August 14th:—English pig lead, £23, 10s. inc.

Messrs. Edward Till & Co. report, August 14th:—India-rubber, Para fine, 11¼d., ¼d. dec.

Lighting and Power Notes.

Barnstaple.—New Plant.—The Town Council has adopted a recommendation by Mr. J. H. Rider to install a further 300-kW Diesel set at the electricity works, which will raise the total cost of the extensions to £36,000. Application is to be made for sanction to the necessary loans to carry out the scheme.

Birkenhead.—New Plant.—The Corporation Electricity Committee has received an intimation from the Electricity Commissioners to the effect that they are not yet in a position to issue formal sanction to the borrowing of £34,046 in connection with the supply of rotary converting equipment, transformers, switchgear, new mains and feeders, but that the works are approved generally, and having regard to their urgent nature, they would raise no objection to the immediate placing of orders for the works to be proceeded with.

Canada.—Montreal.—The city of Montreal, which recently took over the waterworks system from a private corporation, is preparing plans for the generation of the electricity used in its pumping station for street lighting and other municipal purposes. This is expected to make a saving of $500,000 a year. At the present time the power purchased from local companies is 6,000 h.p., and the city pays for this $750,000 per year. The city intends to use the overflow from the aqueduct canal, and at an annual cost of $250,000 to supply its own power for all uses. It is anticipated that the city will be able to generate 20,000 h.p., and sell the surplus not required for municipal purposes to local distributing agencies.

Douglas (I. of M.).—Year's Working.—The accounts of the Corporation electricity undertaking (engineer: Mr. B. Kelly) for the year ended March 31st last record a total income of £31,371, as compared with £25,848 in the preceding year. Working expenses amounted to £15,004, as against £13,021, leaving a gross profit of £16,367 (£12,827), to which was added a balance brought forward from the previous year of £2,573, making a total of £18,940, and after deducting capital charges, &c., there was a balance carried forward of £925. The capital expenditure during the year amounted to £17,797, and the total now spent on the undertaking stands at £187,598. The electrical energy sold increased from 1,185,784 to 1,616,864 kWh, and the maximum load from 804 to 973 kW. In his report, Mr. Kelly states that in the laying out of the proposed new station on the Pulrose site, the possibility of this station being extended later on so as to supply, not merely Douglas, but also the rest of the requirements of the Island, has been borne in mind, although for the present provision has only been made for one 1,000-kW set and two boilers.

Glasgow.—Progress during June.—Under the Corporation Electricity Department scheme 275 houses were wired in June, making the total to date 8,498. The number of applications for the hire of appliances was 211, bringing the total to date to 19,796.

Gravesend.—Loans.—The Corporation Electricity Committee is applying for sanction to loans of £20,000 for mains and £10,000 for services.

Mains Extension.—The Corporation is to extend mains at a cost of £1,700, to enable supplies of electricity to be given to the sanatorium and the Strood hospital.

Hastings.—Loans.—The Town Council has applied for sanction to loans of £10,000 for meters, and £1,360 for mains.

Hawarden.—Electricity Supply Progress.—Another stage in the development of the local electricity supply system has been consummated by the opening of a new sub-station at Ewloe, whence electricity is distributed to the districts of Broughton, Bretton, Sealand, and Penyffordd. No fewer than 1,300 consumers have been connected up.

Hetton (Co. Durham).—Street Lighting.—At a recent meeting of the Urban District Council it was reported that sanction had been received to the borrowing of £5,376 for the conversion of the public street lighting system from gas to electricity. It was decided that the necessary agreement be entered into with Messrs. Reid, Ferens & Co. for carrying out the installation work.

Leicester.—Electricity Extensions.—The Corporation proposes to provide switchgear at a cost of £25,022, and a transformer (£395) in connection with the extensions to the power station. This expenditure is additional to the £640,000 sanctioned in May, 1927, and is expected to be the last of the capital expenditure schemes on the extensions. It is also intended to purchase out of revenue preheating apparatus at a cost of £10,000.

Liverpool.—Year's Working.—We have received a copy of the accounts of the city electricity undertaking (engineer: Mr. P. J. Robinson) covering the year ended March 31st last. The total revenue amounted to £1,288,038, as compared with £1,280,79[illegible] in the preceding year, working expenses and special charges against revenue totalled £814,155, as against £898,645, and there was a gross profit of £473,883 (£382,150), to which was added a contribution of £2,704 to the sinking fund by the Housing Committee, making a total of £476,587 available. This was disposed of as follows: Interest, £232,552; repayment of loans, £533; contribution to Bootle Corporation stock redemption fund, £1,511; sinking fund contributions, £176,806; contribution to city rate, £35,000; renewal fund, £40,184. The capital expenditure during the year amounted to £699,413, and included £44,703 for buildings, £296,977 for machinery, and £366,208 for mains. The total now spent on the undertaking stands at £6,649,337.

Luton.—Loan.—The Town Council has applied for sanction to a loan of £13,304 for overhead lines and switchgear for the proposed supply of electricity to Eaton Bray, Edlesborough, Totternhoe, and other villages. Application has also been made to the Electricity Commissioners for sanction to appropriate from profits £9,692 for meters and house services.

Maidenhead.—Loans.—The Town Council has received sanction to loans of £5,000 for mains, and £3,650 for plant extensions. A further loan of £2,020 for a h.p. feeder and pilot cable from the works to a new sub-station site has been applied for.

Malvern.—Loans.—The Urban District Council has applied for sanction to loans of £1,000 for transformers and £500 for meters.

Manchester.—Progress during June.—During the month of June the Corporation electricity undertaking showed an increase in connections of 2,429 kW, bringing the total up to 358,205 kW; and the number of applications received for supply, including those for additional supplies, was 945, representing a total of 2,421 kW. The number of hired cookers connected increased by 84, bringing the total actually in circuit to 4,585. Applications for the hire of cookers totalled 95. Three new sub-stations were put into commission at Messrs. C.W.S., Ltd., Ollier, Coulthurst, Ltd., and G. Evans and Sons, Ltd., and a new 250-kVA transformer was installed at the Longsight sub-station.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

Finchley.—Lighting: Flat rate from 4½d. to 4d. per kWh; maximum demand rate, after the first 100 hours, from 3d. to 2½d. per kWh.

Stafford.—Lighting: From 8d. to 7d. per kWh.

Bangor.—Power: Primary charge of 15s. per h.p., plus 2d. per kWh for the first 2,000 kWh consumed per quarter, 1½d. for the next 1,000 kWh, and 1¼d. for all over 3,000 kWh, with a rebate of ¼d. per kWh for all energy consumed in excess of 720 kWh per h.p. per annum. Reductions have also been made in the two-part tariffs for lighting.

Watford.—Norwich system: From ¾d. to ½d. per kWh. Lighting: Primary charge from 6½d. to 6d. per kWh; secondary charge from 4d. to 3½d. The cash discount for power and special heating consumers is increased from 2½ per cent. to 5 per cent.

Spalding.—Power: First 450 kWh per quarter, 3d. per kWh; next 450 kWh, 2½d.; beyond, 2d. per kWh.

Dumfries.—Lighting: From 7½d. to 6d. per kWh. Power: From 3½d. to 3d. per kWh. Discounts, varying from 2½ per cent. to 10 per cent., according to the quantity consumed.

Perth.—Lighting: From 4½d. to 3¾d. per kWh. Power: From 3½d. to 2¾d. per kWh. Heating: From 1½d. to 1d. per kW. Public lighting: From 3½d. to 3¼d. per kWh.

Burgess Hill.—*The Burgess Hill & District Electric Supply Co., Ltd.*—Lighting: 10d. per kWh.

Heston and Isleworth.—Lighting: Flat rate from 6½d. to 5½d. per kWh. Power, heating and cooking: First 5,000 kWh per quarter, from 2½d. to 2d. per kWh; next 10,000 kWh, from 2½d. to 1¾d.; next 15,000 kWh, from 1½d. to 1¼d.; beyond, from 1¼d. to 1d. per kWh. "Telephone system": Lighting from £30 to £24 per kW, and power from £5 to £4 per kW per year, plus 1¼d. per kWh.

Hawarden.—Lighting: From 8d. to 7½d. per kWh. Power: From 2½d. to 2¼d. per kWh.

Thornton-le-Fylde.—Lighting: A reduction of ¼d. per kWh. Power: A reduction of ¼d. per kWh.

Reigate.—Electricity Supply.—The Town Council has offered a supply of electricity to the works of the Fullers Earth Union, Ltd., subject to a minimum guarantee of £300 per annum for five years, the charges to be 6d. per kWh for lighting and 1½d. per kWh for power. The extension of mains will cost £1,021.

Runcorn.—Increased Maximum Charge.—After reviewing the facts relating to the Mersey Power Co.'s application to increase the maximum prices in the area of the Rural District Council, the Electricity Commissioners propose to recommend the Minister of Transport to make an Order authorising a maximum charge of 8d. per kWh, subject to certain conditions.

Sheffield.—Year's Working.—We have received from Mr. S. E. Fedden, general manager and engineer of the Corporation electricity undertaking, a copy of his report, together with the statement of accounts covering the year ended March 31st last. The total revenue amounted to £931,472, and working expenses were £380,607, leaving a gross profit of £550,865. The figures for the preceding year were: Income, £776,454; working expenses, £521,431; gross profit, £255,023. To the gross profit was added an unemployment grant of £989, making a total of £551,854, and after meeting capital charges there

was a net surplus of £238,454, as compared with a loss of £52,522 in the preceding year. A sum of £8,978 was transferred to the borough fund. The capital expenditure during the year amounted to £280,968, and included £209,243 for mains. The total now spent on the undertaking stands at £4,714,620. The electrical energy generated increased from 204,159,700 to 235,735,520 kWh (254,420 kWh purchased in bulk), and the sales rose from 170,213,413 to 198,228,994 kWh. The maximum supply demanded reached 88,724 kVA, as against 80,852 kVA in 1926-27. The average price obtained per kWh increased slightly from 1.076d. to 1.113d. During the year 152 miles of additional feeder and distribution mains were laid, bringing the total mileage up to 1,205, and the total connections increased by 10,639 kW to 269,255 kW.

South-East Lancs. Electricity Advisory Board.—NORTH-WEST ENGLAND AND NORTH WALES SCHEME.—The Special Committee *re* District Organisation has considered the possibility of local control for, or assistance of, the Central Electricity Board, and has resolved that the South-East Lancashire and Mid-Lancashire Electricity Advisory Boards be requested to call a joint conference of representatives of owners of selected stations to consider if there is a *prima facie* case for going forward with a scheme to form an association of owners of selected stations for the purpose of making proposals to the Central Electricity Board for delegation by them to the association of their powers in relation to the North-West England and North Wales Area.

FRINGE ORDERS.—The Engineering Advisory Committee has recommended the Board to support the application of Oldham Corporation for fringe orders to supply certain premises in Limehurst rural districts.

The minutes of the proceedings of the two Committees have been approved by the Board.

Special Orders.—Applications have been made to the Electricity Commissioners for Special Orders by the Haywards Heath & District Electric Supply Co., Ltd., to supply electricity in parts of the rural districts of Cuckfield and Chailey, and the Steyning Electric Light Co., Ltd., to supply electricity in the rural district of Thakeham, and parts of the rural districts of Steyning West and Horsham.

Stoke-on-Trent.—LOANS.—The Corporation Electricity Committee is applying for sanction to loans of £20,000 for mains and £10,000 for sub-station equipment.

Wallasey.—YEAR'S WORKING.—The report of the borough electrical engineer (Mr. B. T. Hawkins) on the working of the electricity undertaking for the year ended March 31st last shows a total income of £149,212, as compared with £169,300 in 1926-27, and working expenditure of £74,926, as against £94,323, leaving a gross profit of £74,286 (£74,978). After providing for capital charges there was a net surplus of £36,202, as compared with £39,862 in the preceding year. A contribution of £4,500 was made to the borough fund. The amount spent on capital account during the year was £85,358, the chief items being £31,601 for buildings, and £41,032 for plant and machinery. The sales of electrical energy increased from 27,579,117 to 31,508,691 kWh, and the maximum load from 11,000 to 12,990 kW.

Weybridge.—REDUCTION OF MAXIMUM CHARGE.—The Urban District Council has decided to apply to the Minister of Transport for a reduction in the maximum charge for electricity from 1s. to 8d. per kWh.

Tramway and Railway Notes.

Continental.—SWEDEN.—The report of the district managers of the Stockholm-Gothenburg Railway for 1927, dealing with the first year's operation of this line by electricity, states that on the whole working proceeded according to programme. No serious dislocation of traffic took place, but only interruptions. Most of these arose from defects in the transmission plant of the Waterfalls Administration, falling wires or lack of attention on the part of the personnel connected with the change of locomotives. The frequency of defects in working has been found to be greatest during the summer and least during the spring, autumn and early winter. This result is due to the climatic conditions which bring about atmospheric disturbances during the hottest period of the year, together with damage caused by storms and snow during the winter. Of the interruptions, 71.1 per cent. was due to the failure of the supply of energy, 7.7 per cent to the earthing of wires, 2.7 per cent. to the breakage of insulators, 1.8 per cent. to defects on the locomotives, 1.3 per cent. to defects in cables, and 0.8 per cent. to defects in conductors. The worst interruption in the supply of energy lasted for six hours.

SWITZERLAND.—Two new short sections of electric railway have been inaugurated by the Greyerzer Railway Company, one between La Tour and Montbovon and one between Buadens and Chatel-St. Denis.

The following particulars relative to the working of the tramway in the city are taken from the annual report for 1927 of the Zurich municipal tramway undertaking. Twenty-one routes, extending to 30.7 miles and representing 68 miles of track, are now served by the tramway. At the end of 1927 the rolling stock equipment comprised 203 motor-driven cars and 157 trailers, a number of old motor-equipped cars having been converted to trailers. Of the latter, 98 are now fitted with electromagnetic brakes. The number of car miles run during the year amounted to 9,666,400, as against 8,137,195 in 1926, and the number of passengers carried was 66,013,902, an increase of 5,663,066. The total receipts amounted to £558,744, an increase of £37,136, and operating expenses amounted to £454,782, an increase of £40,188. The report adds that the municipal authorities have voted a sum of £104,800 for the construction of two large new car sheds.

India.—RAILWAY ELECTRIFICATION.—With a view to reducing the running cost, the South Indian Railway proposes to electrify some of its heavily worked sections at an early date. The electrification of the suburban section between Madras Beach and Tambaram has already received sanction from the Railway Board, power for which will be obtained from the Madras Electric Supply Corporation until the Pykara hydro-electric scheme materialises. The other lines which are included in the comprehensive electrification scheme are Madras to Villupuram, a distance of 101 miles, Trichinopoly to Madura, a distance of 96 miles, Podanur to Dindigal *via* Pollachi, 100 miles, a section of the Nilgiri Mountain Railway between Ootacamund and Kunur and another heavily worked line. The electrification of these sections depends mainly on the Pykara hydro-electric scheme being sanctioned. The South Indian Railway has already given a provisional undertaking to take 50 per cent. of the power generated by the Pykara scheme. The comprehensive programme is now before the Railway Board awaiting its sanction.

Isle of Man.—ELECTRIC CAR COLLISION.—*The Times* reports that two cars carrying holiday makers came into collision on the Manx Electric Railway on August 8th. Both cars were completely wrecked, and 25 people were injured. The railway runs from Douglas to the top of Snae Fell Mountain and to Ramsey. One car had set off full of visitors. Near Laxey mining village this car stopped on a bend to permit workmen to repair the overhead wires, and when another car, crowded with visitors, came round the bend, the collision occurred. The stationary car was derailed, and turned completely over.

London.—"UNDERGROUND" IMPROVEMENTS.—According to *The Times*, the reconstruction of the three Underground stations at Charing Cross, on the Embankment, though it is involving much pulling down and building up, is being carried out without interruption of traffic over the six underground tracks of the three railways of which the station is the interchanging point. The number of trains daily is 2,744. Below the station of the District Railway there is an extensive intermediate circulating area for Bakerloo and Hampstead tube passengers. Originally there were four escalators connecting the tube stations with this intermediate landing area. Already two new escalators have been put into service for the Hampstead tube. Two others are being constructed to connect the intermediate area with the street, so that passengers will be able to ascend or descend practically the whole way to or from the street to the deep levels of the tube stations. The two latter escalators will not only be the first to be installed on the District Railway directly connected with the street, but they will be the first on the Underground system which will require no tunnel shaft for working, being made to run in a steel frame in the air. The present booking-hall will be demolished and a new one constructed with an area three times greater (13,000 sq. ft.). The hole-in-the-wall booking hatches will be replaced by the passimeter system of booking. The reconstruction is expected to be completed by January.

Sheffield.—LOANS SANCTIONED.—The Corporation Tramways Committee has received sanction to borrow £148,705 for the construction and equipment of new tramways, and £185,065 for the provision of new tramcars.

South Africa.—SUBURBAN ELECTRIFICATION.—The suburban electrification of the South African Railways at Cape Town is now completed as far as Fish Hook, and a service of passenger trains is now working. Of the automatic sub-stations installed on the line, those in actual operation include Milnerton Junction, Claremont, Muizenberg and Diep River sub-stations, all of which are equipped with the General Electric Co.'s gear.

West Ham.—YEAR'S WORKING.—The report on the working of the Corporation tramway undertaking (manager: Mr. L. Slattery) for the year ended March 31st last shows a total income of £295,292, and working expenditure of £263,689, leaving a gross profit of £31,603. The figures for the preceding year were: Income, £264,885; working expenses, £253,413; gross profit, £11,472, to which was added revenue from other sources making a total of £32,984. Capital charges absorbed £39,918, and the cost of track reconstruction and reseating cars £36,904; the net result, therefore, was a deficit of £43,888, as compared with a loss of £30,975 in 1926-27. The capital expenditure during the year amounted to £33,439, for which track reconstruction and new cars were responsible. The total spent on the undertaking at the end of the year under review was £729,442.

Telegraph and Telephone Notes.

Aircraft Wireless.—Call Signals.—All aeroplanes fitted with wireless apparatus have now been assigned five-letter call signs by the International Bureau at Berne. The first letter is the nationality designation, and the remaining four letters are the registration mark of the aircraft. In the case of several countries having the same nationality prefix, the first letter of the group of four letters also signifies nationality. Thus Haiti begins its four-letter group with H, Holland with N, &c., so that a Dutch plane would be registered H-NADY. British aeroplanes carry the prefix G, and the general call for all R.A.F. machines is G-EZAA.

Estonia.—New Wireless Station.—The *Commercial and Industrial Gazette* reports that the Weak Current Trust has signed a contract for the building of a wireless station at Reval (Estonia) with a power of 5 kilowatts. The Soviet Trust had to meet the competition of important foreign firms.—*Reuter's Trade Service* (Moscow).

International Telephony.—Anglo-Italian Service.—Telephone communication was established on August 9th between all towns in the British Isles and Milan (Italy) *via* Switzerland.

One of the longest telephone lines in Europe became available for public use on August 10th, when calls were accepted from all parts of Germany to certain centres of Spain and Portugal, including Madrid and Lisbon.

Marine Wireless.—Medical Code.—Experiments were recently carried out aboard the Cunard Co.'s liner *Mauretania* by Dr. D. D. F. McIntyre, a Board of Trade medical inspector, in co-operation with Dr. H. C. Case and Dr. P. Morton, in connection with a scheme for the establishment of an international medical marine radio code to enable ships' captains to communicate diagnoses to other vessels, with a view to affording medical assistance to people at sea on vessels not carrying surgeons. The scheme is the work of the British Medical Association's special committee which was formed a year ago, and representatives of the Admiralty, the Board of Trade, the Ministry of Health, the steamship companies, and the Post Office have all combined to produce a code that can be extended for international use.

Sweden.—Telephone Service.—The following information from the Statistical Report of the Swedish Telegraph Department for 1927 has been received by the Department of Overseas Trade from the British Commercial Secretary at Stockholm:—In 1927 the number of telephone stations was 4,735, of which 28 were private. Two automatic telephone exchanges were being built in Stockholm and one in Gothenburg. Conversations numbered 694.6 millions, against 662.1 millions in 1926; of that number 317,000 were to foreign countries, against 308,000 in the preceding year; 298,000 from foreign countries, against 276,000; and 60,000 through Sweden, against 56,000 in 1926. Of 615,000 conversations with foreign countries, Denmark accounted for 260,500, Norway for 197,500, Germany for 126,000, and Great Britain for 3,200 (first year of traffic); traffic commenced during the year with Great Britain, France, Belgium, and the Netherlands. The number of telephones, including extensions, in use was 453,513 (or 74.5 per thousand inhabitants), as against 438,059 in 1926. The income amounted to 75,003,000 kr., as against 72,335,000 kr. in 1926. The length of lines was 828,100 kilometres, as against 798,961 kilometres in the previous year.

The Telephone Service. — Progress.—Figures collected recently by the General Post Office to illustrate the development of the telephone service in this country in recent years show that at the end of March the number of telephones in use was 1,631,191, a net increase during the year of 122,405, which was a record for this country. The United States leads the world with 18,500,000 telephones, while Germany has 2,800,000 and Canada 1,200,000. In density of telephones according to the population, says *The Times*, during the past three years this country rose from the ninth to the eighth place. The rate of increase during the past three years was 15 per cent. in the United States, 18 per cent. in Germany and Canada, and 28 per cent. in Great Britain. The increase in the number of call offices has been 5,224, or 27.7 per cent., and the total number of call offices now open is 24,054, of which 5,244 are in London and 18,810 in the provinces. The receipts from call offices last year amounted to £953,428, an increase of £61,710, or 6.9 per cent. Inland trunk calls in the year ended March 31st numbered 102,350,000, an increase of 7,689,000, or 8.1 per cent. Receipts were £4,465,000, an increase of £268,000, or 6.4 per cent. The number of rural exchanges increased by 469, and the total number of rural call offices now open is 7,627. There are now 890 rural stations on the telephone, an increase during the year of 145. The total amount of capital actually invested in the telephone enterprise of this country has reached £112,000,000. Of this amount £43,000,000 has been repaid, leaving an amount at present invested of £69,000,000, against which there are assets valued at a depreciated value of £91,000,000. One of the most striking developments in the past three years has been in the increased international use of the telephone. The Transatlantic telephone service already covers the operating costs and all interest and depreciation charges on that part of the Rugby station which is used for the service. The largest number of calls in one week was reached early in May, when the figure rose to 317.

Transatlantic Telegraphy.—New Cable.—What will be, it is claimed, the world's fastest submarine telegraph cable is to be laid for the Western Union Company by the cable ship *Dominia*, belonging to the Telegraph Construction and Maintenance Company, which sailed from Greenwich on August 7th for Horta, Fayal, Azores. When the survey of the route has been completed at Bay Roberts, Newfoundland, *Dominia* will begin the laying operation in the latter part of this month, and it will be completed on or before September 10th, thus opening a new channel of communication between North America and Germany, Italy and Africa. The new cable will represent an advance in ocean telegraph engineering. It will make possible the simultaneous transmission of five messages in each direction, ten messages in all, over the cable between Bay Roberts and Horta, whence eastbound traffic will be divided and routed over cables to Germany, Italy and Africa.

United States.—Telegraph Merger?—Prevented by law from combining with the Radio Corporation of America to form one trust, the International Telephone and Telegraph Corporation is reported to have formed two new companies designed to meet foreign competition. The two new subsidiaries, called International Communications Corporation and International Cables Corporation, with nominal capitalisation, have broad powers to operate, own, lease and construct cables, telephone lines, radio-broadcasting stations, television apparatus, telegraph and radio-telegraph systems throughout the world. It is suggested that the company may be laying the ground work for a communications merger in case the repeal of the White Act, which forbids mergers of wireless with cable companies, can be obtained. It is learned also that the International Telegraph and Telephone Co. has concluded a contract with the Western Union Telegraph Co., whereby the latter is granted the use of the International Co.'s wire systems, paving the way for the eventual elimination of equipment duplication. It has also contracted to lease to the Western Union Co. apparatus developed in the International Co.'s laboratories, thereby enlarging the capacity of the Western Union's present equipment. Similar contracts are available to other telegraph companies.

Radio Notes.

Photo-telegraphy.—B.B.C. Tests.—It is reported that the British Broadcasting Corporation has been carrying out tests for some time with the object of determining whether it will be practicable to inaugurate an experimental service of picture transmission in the autumn—on no account to be confused with television. Several systems have proved successful; the "Fultograph," the invention of Captain Otho Fulton, an Englishman, is used by the Vienna broadcasting station, the only broadcasting station in the world which transmits pictures as well as speech and music. A station cannot simultaneously transmit ordinary broadcast matter and pictures unless it uses two wave-lengths. All receivers must be of the same make as the transmitter, to ensure synchronisation.

Sweden.—Licences.—The following information extracted from the statistical report of the Swedish Telegraph Department for 1927 has been received by the Department of Overseas Trade from the Commercial Secretary at Stockholm (Mr. W. Peters):—At the end of 1927 there were seven broadcasting stations belonging to the telegraph service, with an average yearly service of 2,043 hours per station, and 24 smaller private relay stations. The big Motala station was put into operation in the middle of 1927. The stations at Gothenburg and Malmö are to be enlarged to 10 kW. The licence fee is Kr.10. The number of licences granted at the end of the year for receiving apparatus was 328,133, or 53.9 per 1,000 inhabitants, as against 242,559 and 39.9, respectively, at the end of 1926. Stockholm 56,931, or 90.5 per 1,000 inhabitants (80.0 in 1926); Gothenburg 29,051, or 77.4 per 1,000 (81.6); and Malmö 16,703, or 98.7 per 1,000 (101.9).

United States.—New Receiver Patent.—A new radio patent, which is said to cover features found in all types of broadcast receivers now manufactured for general sale, has been announced by Mr. Edward H. Loftin, co-inventor with Mr. William F. Grimes. The serial number is 1,675,186 of June 26th, 1928, and the patent has been assigned to Mr. Loftin as trustee. "The claims allowed by the United States Patent Office are extremely broad," according to the *T. & T. Age*, "for a principle that has proved essential to efficient amplification in tuned radio-frequency receivers capable of bringing in distant stations." The application for the system is said to have been filed with the Patent Office more than five years ago.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—October 2nd. Posts and Telegraph Department. Switchboard cords. (B.X. 4621.)*

November 6th. Automatic telephone switching equipment. (B.X. 4638.)*

October 16th. Telephone register coils and mounting plates. (B.X. 4639.)*

October 22nd. State Electricity Commission of Victoria. Transformer and spares for the Yallourn power station and the Richmond terminal station. (B.X. 4637.)*

Belgium.—ANTWERP.—September 27th. Municipal Council. Thirty-two 3-ton electric cranes. Particulars from Hotel de Ville, Antwerp.

Berkhamsted.—August 21st. Board of Guardians. Electric lighting installation at the Institution. Mr. A. Brooke Turner, clerk.

Birmingham.—August 25th. Asylums Committee. Installation of electric lighting and power at the Winson Green Mental Hospital, Lodge Road, Birmingham (approximately 1,000 lighting points). Specification from the Mechanical Department, 12, The Crescent, Cambridge Street, Birmingham.

August 25th. Board of Guardians. Installation of electric lighting in the Pathological Department at the Selly Oak Hospital. Specification (21s.) from the Clerk to Guardians, Union Offices, Edmund Street, Birmingham.

Brentwood.—September 8th. Essex and Colchester Mental Hospital Committee. Electric cables, conduits and control gear for the Brentwood Mental Hospital. (See this issue.)

Bristol.—August 30th. Board of Guardians. Electrical fittings for six months. Mr. T. S. Lamb, clerk, St. Peter's Hospital.

Edinburgh.—September 7th. Corporation. Structural steel work for coal bunkers in the electric generating station extension, West Bank, Portobello. Schedule from city architect.

Enniscorthy.—August 22nd. Urban District Council. Pumps and electric motors in connection with the water supply. Mr. P. H. McCarthy, consulting engineer, 26, Lower Leeson Street, Dublin.

Exeter.—September 1st. Standing Committee for Devon. Supply of electric lamps for three years for use of the police. Forms of tender from the Chief Constable of Devon, The Castle, Exeter.

Glasgow.—August 20th. Corporation. Electric lighting installation for Crossloan Road, Govan, and Keppochhill Road housing schemes. Specifications from Manager, 75, Waterloo Street, Glasgow.

Harrogate.—August 25th. Electricity Department. Two 2,500-kVA 3-phase transformers, 11,000-V switchgear, and one 30-ton travelling crane. (August 3rd.)

Irish Free State.—DUBLIN.—Electricity Supply Board. August 22nd. 32 kiosk and 13 pole-type transformer stations, with switchgear and transformers. (August 3rd.)

Switchgear and three 12,000-kVA transformers for the Shannon transformer station. (See this issue.)

Kendal.—Corporation.—One mile 6,600-V cable, with pilot and three miles of l.p. cable. (August 10th.)

Llandudno.—September 4th. Electricity Department. E.h.p. and l.p. cables, cubicles, transformers and unit-type feeder pillars. (August 10th.)

Llantarnam.—September 3rd. Urban District Council. H.p. and l.p. switchgear, transformers, and overhead and underground mains. (July 27th.)

London.—METROPOLITAN ASYLUMS BOARD.—August 22nd. Rewiring fire-alarm system at Caterham Mental Hospital. Installation of electric lighting in shore and pier buildings, Long Reach Hospital, Dartford, Kent. (July 20th.)

August 22nd. Installation of wireless equipment at Grove Park Hospital, Lee. (August 10th.)

ST. PANCRAS.—September 4th. Electricity Department. One 15,000-kW generator, condenser, and auxiliaries for the King's Road generating station. (August 3rd.)

HACKNEY.—August 29th. Board of Guardians. Installation of telephone and fire-alarm system at the Branch Institution and School, Brentwood. (August 10th.)

STOKE NEWINGTON.—Electricity Department. Twelve months' supply of paper-insulated, lead-sheathed and armoured cables; 12 months' supply of d.c. house service meters. (See this issue.)

H.M. OFFICE OF WORKS.—September 4th. Supply of electrical and mechanical engineering labour on daywork in Cardiff (See this issue.)

Manchester.—August 22nd. Electricity Committee. Electric cooking ranges. (August 10th.)

August 31st. Eight 250-kVA, eight 500-kVA, and two 125-kVA static transformers. (August 10th.)

Hospital Sub-Committee. Electric lighting installation for the Baguley Sanatorium. (August 10th.)

New Zealand.—WELLINGTON.—September 11th. Public Works Department. Two 10-cwt. electric travelling indoor cranes. (A.X. 6545.)*

October 30th. Protective relay system. (B.X. 4573.)*

September 4th. Insulating tape. (B.X. 4572.)*

September 25th. Meter-testing equipment for Lake Coleridge. (B.X. 4570.)*

DUNEDIN.—September 28th. Otago Harbour Board. Two 3-ton electric wharf cranes. (A.X. 6621.)*

Oldham.—September 10th. Board of Guardians. Electric lamps and fittings for the Institution, Rochdale Road. Form of tender, &c., from Mr. F. W. Fletcher, clerk to Guardians, Union Offices.

Pentre, Rhondda.—September 4th. Rhondda Urban District Council. Electricity Department. One 150-kVA, 3,500/414-V, 3-phase static transformer and one 150-kVA, 11,000/414-V ditto. (See this issue.)

Rochdale.—August 31st. Electricity Department. 500 electric wash boilers during 12 months. (August 10th.)

South Africa.—JOHANNESBURG.—September 11th. Rand Water Board. Turbo-generator for the Vaal River scheme. (B.X. 4585.)*

August 30th. Town Council. Street-lighting time switches. (B.X. 4584.)* 1,000-kVA and 250-kVA transformers. (B.X. 4618.)* Six 10-kVA induction voltage regulators. (B.X. 4617.)*

October 26th. Electricity Supply Commission of South Africa. Plant and equipment for a hydro-electric power station and outdoor sub-stations. (B.X. 4622.)*

Railways and Harbours.—September 20th. One electrically-driven heavy-duty double-face-plates wheel lathe for Germiston repair shops. (A.X. 6660.)*

VOLKSRUST.—September 11th. Municipal Council. Switchgear, motors, meters, cables, &c. (B.X. 4599.)*

CAPE TOWN.—September 4th. Electricity Department. One 1,000-kW convertor set. (B.X. 4604.)*

August 31st. 29,300 yd. multi-core paper-insulated lead-covered cables. (B.X. 4633.)*

Salford.—August 31st. Board of Guardians. Electric lighting and power installation for the new garage and East End Rooms of the Eccles New Road Institution. (See this issue.)

Stoke-on-Trent.—September 12th Electricity Department. Two water-tube boilers (60,000 lb. per hour). (August 3rd.)

Electricity Department. One 1,200-amp. secondary storage battery. (See this issue.)

Uruguay.—MONTEVIDEO.—September 10th. State Electricity Department. 338,000 metres of insulated conductors for outdoor use (Hackethal type). (B.X. 4589.)*

September 3rd. 155,000 metres of r.i. wire for indoor installations. (B.X. 4590.)*

September 17th. 4,500 metres lead-covered cable, with junction and terminal boxes. (B.X. 4608.)*

September 19th. Lead-covered conductors. (B.X. 4607.)*

Walsall and West Bromwich.—September 28th. Unions Joint Committee. Supplies, including electrical fittings. Form of tender, &c., from Mr. A. H. Ward, clerk ,22, Lombard Street, West Bromwich.

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* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Argentina.—BUENOS AIRES.—A contract for Riley stokers for the Pedro Mendoza station at Buenos Aires has been secured by Riley Stoker Co., Ltd., acting as sub-contractors to Babcock & Wilcox, Ltd.

Ashford (Kent).—Urban Council. Accepted:—
Water softener (£130).—United Water Softeners, Ltd.

Bolton.—Works Committee. Accepted :—
One 10-ton electric crane at Chandos Street warehouse.—S. H. Heywood & Co., Ltd.

Brentford.—Great Western Railway Co. Accepted:—
2-ton electric transporter crane for the docks.—S. H. Heywood & Co.

Canterbury.—City Council. Accepted:—
1,875-kW turbo-alternator.—Brush Electrical Engineering Co., Ltd.
Two 15,000-lb. boilers.—Babcock & Wilcox, Ltd.
The amount of the two contracts is £23,487.

Cumnock.—Town Council. Accepted:—
Lamps, fittings, &c. (£202).—General Electric Co., Ltd.

Douglas.—Corporation. Tenders received for generating plant for the Douglas Corporation (Isle of Man) to the specifications of Messrs. Handcock & Dykes.

Two water-tube boilers with underfeed stokers and all accessories—

Stirling Boiler Co., Ltd.	£18,123
Babcock & Wilcox, Ltd.	18,357
RICHARDSONS, WESTGARTH & Co., LTD. (Accepted.)	18,397
John Thompson Water-Tube Boilers, Ltd. ...	18,900*
Yarrow & Co., Ltd.	18,917
Clarke, Chapman & Co., Ltd.	21,769

One 1,000-kW steam turbo-alternator with all accessories—

W. H. Allen, Sons & Co., Ltd.	£ 9,864
Metropolitan-Vickers Electrical Co.	10,332
Do. do. (alternative)	10,188
English Electric Co., Ltd.	10,426
RICHARDSONS, WESTGARTH & Co., LTD. (Accepted.)	10,700
Fraser & Chalmers Engineering Co.	11,244
Peter Brotherhood, Ltd.	11,284
Daniel Adamson & Co. (Mather & Platt alternator)	11,298
British Thomson-Houston Co., Ltd.	11,473
Belliss & Morcom, Ltd.	11,495
Brush Electrical Engineering Co., Ltd.	12,907
C. A. Parsons & Co., Ltd.	16,610

Contract for both sections placed with Richardsons, Westgarth & Co., Ltd., at £28,200.

Glasgow.—Gas Committee. Recommended:—
Sixteen steam, temperature, and pressure recorders for Dawsholm gasworks (£1,027).—Electroflo Meters.

Cleansing Committee. Accepted :—
Electric lighting installation at Govan depôt (£212).—Grindley, Ross & Co., Ltd.

Tramways Committee. Accepted :—
D.c.c. wire.—W. T. Henley's Telegraph Works Co., Ltd.
Copper bonds.—Thomas Bolton & Sons, Ltd.
Tram rail anchors.—Bolckow, Vaughan & Co., Ltd., and Thomas Green & Son, Ltd.
Insulated bolts.—British Insulated Cables, Ltd.
Armature coils.—P. R. Jackson & Co., Ltd.
Points and crossings.—Hadfields, Ltd.
Petrol-engine starter.—Equipment & Engineering Co.

Electricity Committee. Recommended :—
Switch-fuse equipments for alternators (£175).—English Electric Co., Ltd.

Watching and Lighting Committee. Recommended :—
Twin cable conductors (£1,209).—Metropolitan Electric Cable & Construction Co., Ltd.

Corporation. Accepted :—
Additional electrical work at Mearnskirk Sanatorium (£142).—A. Anderson, Ltd.

Clyde Navigation Trustees. Accepted :—
One 175-ton electrically-operated cantilever crane (£52,000). Cowans, Sheldon & Co., Ltd.

Gravesend.—Electricity Committee. Recommended :—
Kiosk (£180).—Yorkshire Switchgear Co., Ltd.

Leeds.—Works Committee. Accepted:—
Electric motor for Kidacre Street destructor (£118).—Electromotors, Ltd.

London.—ADMIRALTY.—Accepted :—
A. W. P. electrodes for 12 months.—Alloy Welding Processes, Ltd.

Maidenhead.—Town Council. Accepted:—
Three additional kiosks (£470).—W. Lucy & Co.

Manchester.—Electricity Committee. Accepted:—
6,600-V sub-station switchgear for two years.—Ferguson, Pailin, Ltd.

* Includes for boiler casing of steel.

Newcastle-on-Tyne.—Health Committee. Accepted:—
Electric lighting installation at Home for Incurables (£420).—Devereux, Moodie & Co. Electric lift at Home for Incurables (£621).—Austin & Co.

New Zealand.—A *Reuter* dispatch states that the National Electrical and Engineering Co., Ltd., has secured the contract for electric locomotives for the Tawa Flat Railway deviation, and Metropolitan-Vickers Electrical Co., Ltd., the contract for switchgear and steelwork for the Arapuni Hydro-Electric Works

Sheffield.—Electricity Committee. Accepted:—
Seven wrought-iron coal shoots for Blackburn Meadows station (£153).—Hydes & Wigfull, Ltd.

Sleaford.—Urban Council. Accepted:—
Maintenance of the storage battery at the electricity works for a period of ten years (£750).—Edison Swan Electric Co., Ltd.

Sunderland.—Corporation.
L. and m.p. lead-sheathed cable.—Pirelli-General Cable Works, Ltd.
E.h.p. lead-sheathed cable.—British Insulated Cables, Ltd.
V.i.r. wires and flexibles.—Edison Swan Electric Co., Ltd., and Macintosh Cable Co., Ltd.
Lamps.—General Electric Co., Ltd.

Swindon.—Great Western Railway Co. Accepted:—
16 air-cooled engines in connection with the conversion of electric trucks to petrol-electric drive at works.—Coventry Victor Motor Co.
Supply, delivery, jointing and connecting up of h.p. cables and supervision of cable laying at works.—Siemens Bros. & Co., Ltd.

Walton-on-Thames.—Urban Council. Accepted :—
Cables (£2,124).—Greenwich Cable Works, Ltd.
A.c. meters.—Landis & Gyr, Ltd.
Motors (£604, less allowance for old motors).—Hopkinson Induction Motors, Ltd.
Converting wireless sets for use on a.c.—Martins, Ltd.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following :—

Loud speaker marked GRAWOR, BERLIN, VIOLON.
MERCURY switches.
Suppliers in London of self-contained flashing lamps for signs.
Makers of apparatus for bleaching dressed leather.

Notes.

Kaplan Turbine Tests in Germany.

Last year two Kaplan water turbines, built by the Escher Wyss Company, were installed at the Donaustettin hydro-electric station, which supplies power to the municipal tramways and electricity works of the German town of Ulm. Both machines are designed to operate at 214 r.p.m., one working under a head of 24 ft. and taking 4,777 gallons of water per second, while the other works under a 25-ft. head and uses 4,939 gallons per second. The acceptance tests were conducted by Prof. Dr. Braun, of the Technical High School in Stuttgart. The most difficult part of the measurements, *viz.*, the determination of the water volume, was performed with the utmost care, six automatically-recording measuring propellors being employed simultaneously. The test results are claimed to be among the best so far obtained with low-pressure plant, seeing that the maximum efficiency obtained was 92 per cent. A graph of the results also showed that from 40 per cent. of maximum turbine output the efficiency was higher than 90 per cent. The turbine speed chosen at the time of the order was regarded as very high, especially in view of the fact that the head increases to 28 ft. Thanks, however, to the careful design of the turbine, of the spiral intake, the draught tube, appropriate form of the blades, and the non-crowded lay-out of the whole plant, it is claimed that the results indicate that the Kaplan low-presure turbine, so far as its efficiency is concerned, is rapidly approaching the quality of

electric generators. The Donaustettin turbines also satisfy all requirements mechanically; they run quietly and steadily, and the governor control gear of the runner wheel functions regularly, both in the mechanical and hydraulic sense.

American Copper Mines Electrification.

Complete electrification of the Utah, U.S.A., mining properties of the Utah Copper Company, involving a minimum of 20 electric locomotives and a maximum of approximately 40, has been announced by that company. Although the actual mining operations are already electrified, the haulage system has up to the present been of the steam type. The copper ore is found in both sides of the canyon in which the town of Bingham is situated; electric shovels, working on successive terrances cut in the mountain face, remove the overburden which covers the ore, and then the ore itself. The overburden is deposited in cars which will be hauled away by the electric locomotives and dumped down another side of the mountain, while the ore itself, also deposited in cars, is hauled away to mills at Magma, 17 miles away. The decision to change over from steam to electric haulage follows a test of about a year with a trial installation of a 75-ton combination storage battery, trolley and cable-reel locomotive built by the General Electric Company of America. Of the first 20 locomotives, however, two only will be equipped with storage batteries, the remainder drawing power from overhead and side-arm pantagraph trolleys, or from trailing cables. The original locomotive was specially designed for service at this mine, the peculiar arrangement of the "benches" making it necessary to operate the locomotive by means of each and all of the power collection devices described. Power for the locomotives will be supplied from two sub-stations, and an extensive system will be necessary for distribution. The electric locomotives are described as being of the articulated-truck, steeple-cab type with rigid frame, made up of heavy steel plate sides carried on combination semi-elliptic and helical springs. Four large totally-enclosed electric motors will drive each locomotive, the armatures running on roller bearings. Single-unit, three-speed control will be arranged for series, series-parallel, and parallel operation with resistors of sufficient capacity for the specified service cut in and out by solenoid-operated contactors. The overhead pantagraph trolley on each locomotive will be raised by a spring and lowered by air; in addition, there will be two side-arm pantagraph trolleys, one mounted on each side of the cab room, extended and withdrawn by air. Mounted under the platform beneath the cab, a reel will carry a length of flexible rubber-covered cable, and be driven by a motor which will automatically wind and unwind the required length of cable as the locomotive moves toward or away from the source of power.

Lowdon Bros. & Co., Ltd., v. Begg & Son.

At Dundee, plaintiffs sued for £22 19s. 8d. from R. G. Begg and Son, Balmoral Works, Blairgowrie. Respondents counter-claimed on the ground that an engine purchased by them did not conform to warranty and that parts of it were missing. The Sheriff granted Lowdon Bros. the sum sued for and repelled the counter-claim. The action was over an engine sold to the respondents, who alleged that one flywheel was broken and that parts were missing. The Sheriff stated that even if the respondents had a well-founded counter-claim they could not possibly recover the amount claimed, which was between two and three times as much as they paid for the whole engine.

Appointments Vacant.

Mains assistant for the Darwen Corporation Electricity Department. Shift engineer (temporary) (81s.) for the Institution of Mental Defectives, Whalley, near Blackburn. Telephone equipment engineers and draughtsmen for the Automatic Manufacturing Co., Ltd. Works manager for the Loewe Radio Co., Ltd. Shorthand-typist (£182) for the Metropolitan Borough of Hackney Electricity Department. Shift engineer for the Southport Corporation Electricity Department. (See our advertisement pages to-day.)

An American "Capacitor" Installation.

Transmission characteristics closely approaching those of high-voltage direct current are said to have been realised recently with the installation by the General Electric Company of America of three series capacitors on a tie-line operated by the New York Power and Light Corporation at Ballston Spa, N.Y., U.S.A. Connected directly in series with a 33,000-volt, 7,500-kVA line running from Amsterdam to the Ballston sub-station, they compensate for transformer and line reactance at all loads, and the electrical effect is said to be equivalent to placing the Ballston sub-station close to the Amsterdam generating station, 20 miles away; the ohmic resistance of the intervening line is all that remains. It has long been realised that direct-current transmission at high voltage would give ideal performance characteristics; the series capacitor, however, is a solution of the problem from another angle, for it has eliminated some of the most serious limitations of alternating-current transmission by nullifying the reactance. The installation, which has been in continuous operation since February, 1928, has shown that it is entirely feasible to transmit power through the dielectric of the capacitors; automatic protective equipment is included, which has proved successful in meeting all conditions of switching short-circuit, and lightning so far encountered. The installation consists of three single-phase capacitors, each rated 415 kVA, 3,170 volts, 132 amperes, 60 cycles; each is mounted in an oil-filled tank, and is self-contained. The automatic protective equipment is designed to by-pass the unit during short-circuit conditions, and to restore the line connections when normal conditions are resumed; it consists of a sphere gap connected across each capacitor, combined with a high-speed contactor which automatically closes in case of a flash-over of the protective gap; the entire mechanism is mounted in two steel cabinets supported upon the tank structure. The series capacitor itself consists of a group of capacitor units mounted in three tiers upon steel framework resting upon insulators, and the whole is immersed in oil. The advantages of the system, according to Mr. T. A. E. Belt, are as follows: First, long-distance transmission of power at lower voltages. Secondly, a marked increase in the stability or power-carrying capacity of long lines. Thirdly, automatic voltage regulation without auxiliary regulating equipment. Fourthly, compensation for part of the reactance in a line so that it will share its proper division of load when paralleled with another transmission line of widely different characteristics. Fifthly, significant reduction of the expense of building, installing, and maintaining voltage-regulation equipment, as compared with synchronous machines; this reduction will be further increased by the fact that the capacitors are installed out of doors, and hence eliminate the expense of buildings, &c., incident to synchronous condenser installations. Sixthly, a promising field for the series capacitor in making possible small rural lines, now prohibitively expensive in sparsely settled districts. Comparison of the series capacitor with synchronous condensers, induction voltage regulators, and tap-changing transformers indicates, it is claimed, that in many cases the series capacitor is by far the cheapest means of compensating for the reactive drop of the system.

Sydney Bribery Charges.

The London newspapers have published dispatches from Sydney stating that Mr. S. Y. Maling, who was reported to have "disappeared," has not left the State, but is "resting in the country," and if the authorities require him to attend as a witness they can communicate with his solicitors.

The Sydney correspondent of *The Times* says that before the Royal Commission which is inquiring into the civil coal contracts, Mr. Nicol Peacock, an agent, said on Tuesday that he gave Mr. James Johnstone £200 to give to Mr. Silas Maling for the purpose of securing coal contracts, and saw Mr. Johnstone hand a package of notes to Mr. Maling. "Mr. Peacock said that he also paid Mr. Richard Woof, the power house superintendent, 1d. per ton on coal delivered under contract. It was, he stated, customary to make these payments in the engineering trade. Mr. James Johnstone corroborated Mr. Peacock's statement, and added that he had also paid ex-Alderman Farrell £200. In 1921 Mr. Maling told the witness that Mr. Peacock could get a contract if he paid a secret commission. The witness offered £1,500. Mr. Maling told him to inform Woof that £1,200 was being paid, and to say nothing about £300 for Maling himself."

Matthew Murray Memorial.

A movement is on foot to carry out a memorial scheme in honour of the work of Matthew Murray, a Leeds engineer, who did remarkable pioneer work over 100 years ago. Mr. G. S. Wainwright, of 5, Allerton Avenue, Leeds, is hon. treasurer, and Mr. E. Kilburn Scott, M.I.E.E., hon. secretary of the Memorial Fund.

Municipal Engineers as Technical Advisers.

We have received from Mr. A. H. Dykes, M.Inst.C.E., hon. secretary of the Association of Consulting Engineers (Incorporated), a copy of a letter which his Committee has addressed to the London and Home Counties Joint Electricity Authority, expressing regret that the Joint Electricity Authority, being desirous of obtaining technical advice, proposes to retain the services of Mr. F. W. Purse, M.I.E.E., electrical engineer and manager of the West Ham Corporation, assisted by a panel of other Corporation engineers, to advise upon various matters, such as the proposed transfer of purchase rights from Local Authorities to the Joint Authority, and the re-arrangement of electricity distribution areas; the proposed co-ordination of the generating sources and main transmission lines of Local Authorities within the Authority's district; the consideration of proposals relating to the erection of new stations, the extension of existing stations, the construction of main transmission lines, and bulk supplies; the investigation into questions relating to electricity charges, and provisions of supplies, and technical matters arising from time to time. The Committee believes that previous to the appointment of Mr. S. J. Watson as chief engineer, the Authority retained the services of the well-known consulting engineer, Mr. J. H. Rider, and expresses surprise that in the present instance the Authority should seek to retain as its consultant an official who is closely identified with one branch of municipal electricity supply.

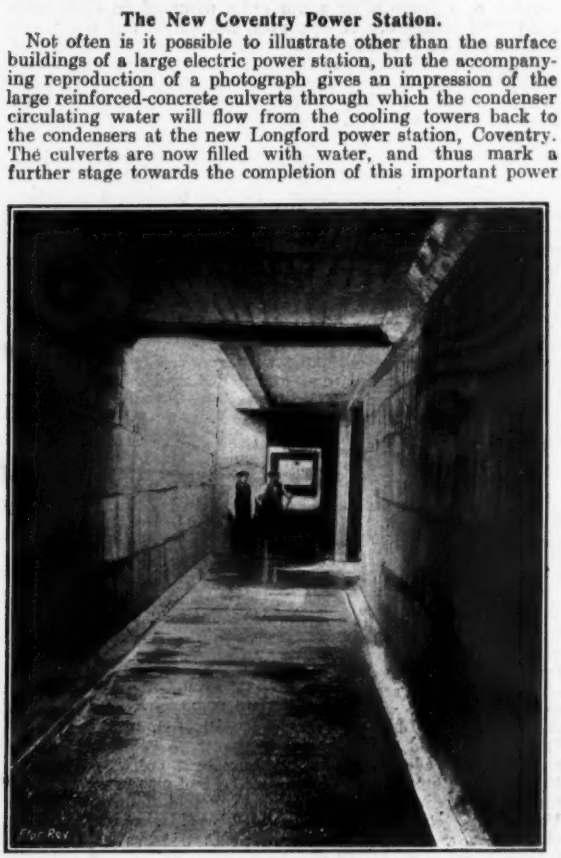
It appears to the Committee to be wrong in principle for public bodies to retain as their consultants officials of other public authorities; from the nature of their ordinary employment, such engineers, it is held, can hardly be expected to

take the same unbiased view that is to be expected from a consultant who operates in a much wider sphere of work, particularly when a consulting engineer is required to advise a Board composed of a number of authorities, where professional perspective is required as well as technical experience.

The Committee expresses the hope, therefore, that on further consideration the Authority will not proceed with the suggested appointment, but when expert assistance is required will retain the services of some well-known consultant fully familiar with the questions under consideration.

The New Coventry Power Station.

Not often is it possible to illustrate other than the surface buildings of a large electric power station, but the accompanying reproduction of a photograph gives an impression of the large reinforced-concrete culverts through which the condenser circulating water will flow from the cooling towers back to the condensers at the new Longford power station, Coventry. The culverts are now filled with water, and thus mark a further stage towards the completion of this important power



Condenser Water Culverts at Coventry.

station, for which the contract is in the hands of the British Thomson-Houston Co., Ltd., all the work being carried out to the specification of Mr. Geo. Tough, O.B.E., M.I.E.E., city electrical engineer and manager.

Canadian Hydro-Electrical Developments.

Some interesting data recently compiled by the Canadian Dominion Water Power and Reclamation Service concerning Canadian hydro-electric projects are given in the July 24th issue of *Power*. Approximately 550,000 h.p. of turbine capacity will be installed for entirely new developments or as additions to existing stations during the present year. The undertakings at present in the initial stages of construction will, within the next few years, result in the addition to the total installed capacity in the Dominion of over 2,000,000 h.p. In British Columbia the Bridge River Power Co. is putting down a station which will have an ultimate capacity of 500,000 h.p., and will be the largest in the province; two 28,000-h.p. units are planned to be installed by the end of 1930. The 60,000-h.p. development of the West Kootenay Power & Light Co. is expected to be completed towards the end of this year. The West Canadian Hydro-Electric Corporation has commenced the construction of a 2,000-h.p. plant on the Shuswap River which will supply Vernon and other nearby municipalities. The Manitoba Power Co. is adding two 28,000-h.p. units to its Great Falls station, bringing it up to 168,000 h.p., its ultimate designed capacity.

In Ontario the Ontario and Minnesota Power Co. is completing its third plant on the Seine River; this development will have an installed capacity of 13,200 h.p. On the Gatineau River, the province of Quebec, the Gatineau Power Co. has brought well towards completion its development at Paugan Falls, which will have an initial installation of six units of 34,000 h.p. each. The same company plans to add a fourth unit of 34,000 h.p. to its Chelsea plant, a 24,000-h.p. unit to the Farmers Rapids plant, and to complete a second 25,000-h.p. unit in its recently-acquired Bryson plant on the Ottawa River. On the Saguenay River the Duke-Price Power Co. has still two units to install to reach the ultimate designed capacity of 540,000 h.p. One of these units will be installed before the end of this year. The Montreal Island Power Co. has recently let a contract for a 65,000-h.p. development on Des Prairies River, and it is expected that the initial installation of 40,000 h.p. will be ready for operation in 1929. On the Saint John River at Grand Falls, New Brunswick, the Saint John River Power Co. is rapidly bringing to completion the construction of a hydro-electric plant which will have an ultimate capacity of 80,000 h.p.

A Diesel-Electric Towboat.

A new Diesel-electric towboat, the *Tecumseh*, the fourth of its kind to be built and the second of its size to be equipped with Diesel-electric propulsion, is shortly to be put in service in the St. Louis district by the U.S. Engineering Corps. The boat was given dock and river trials recently in the Kanawha River at Charleston, West Virginia, U.S.A., and the final completing details are being added by the builders, the Charles Ward Engineering Works, Charleston. The new boat was completely electrified by the General Electric Company of America; the power plant consists of a 300-h.p. Lomboard Diesel engine driving a 210-kW, 400-r.p.m., 190/315-volt generator and a 20-kW, 400-r.p.m., 120-volt, compound-wound generator. The larger generator will supply power to two 115-h.p., 360/600-r.p.m., shunt-wound propulsion motors, and the smaller will supply power for running auxiliaries and for lighting, as well as excitation for the main generator and propelling motors. The propeller is of the paddle-wheel type, located at the stern, and is driven through two sets of link-belt chains. The speed of the boat is controlled by a unique method: the motors run at all times (except during manœuvring) at speeds suitable to take exactly full-load power from the prime mover; as a result, maximum overall speed and highest efficiency are automatically obtained at all times. In normal operation, the pilot house operator sets the control handle at either the "full ahead" or "full astern" position, and the speed control thereafter is automatic; should the pilot desire lower speeds than those automatically provided, they can be easily selected. Control of the propulsion equipment is of the variable voltage type, the main control panel, auxiliary switchboard, controlling rheostat, &c., being located in the engine room. There are two control stations, one in the pilot house and one in the engine room, and indication is provided in the pilot house to show at all times the propeller speed and the main generator output. All of the auxiliaries on the boat are electrically driven.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

The Glasgow Corporation Special Sub-Committee on Reorganisation of the Electricity Department recommends that the appointment of Mr. H. BELL as general manager shall be subject to the following terms and conditions:—(1) The appointment shall be held during the pleasure of the Corporation; (2) the general manager shall devote his whole time to the duties of his office; (3) the general manager, under the direction and subject to the control of the Corporation, shall have the full management of the department, and shall be responsible to the Corporation for the good conduct of all persons employed by him or by those acting for him, and generally for the efficiency of the department; and (4) the following principal officers shall hold their appointments from the Corporation: the assistant engineer, the secretary and treasurer, power stations superintendent, sub-stations superintendent, chief technical assistant, mains superintendent, and chief constructional engineer, and subject to the terms of these appointments, the general manager, or the principal officers acting for him, shall have power to appoint, suspend, or dismiss any persons employed in the department.

The Corporation Electricity Committee having considered the letter of Mr. Herbert Bell regarding superannuation, it was moved that Mr. Bell's appointment be subject to the following further conditions:—(1) That, on attaining the age of 65 years,

he shall retire from the service and thereafter receive during his lifetime a retiring allowance to be paid out of the funds of the electricity department, of a sum equal to one-half of his average annual salary during the seven years ending on the date of retirement; (2) that, in the event of his becoming incapacitated, prior to his attaining the age of 65 years, for the efficient discharge of his duties by reason of permanent ill-health or infirmity of mind or body as such ill-health or infirmity shall be certified by a medical practitioner to be appointed by the Corporation, he shall retire and shall receive during his lifetime a retiring allowance to be paid out of the funds of the electricity department of a sum equal to one-sixtieth of his average annual salary during the seven years ending on the date of retirement for each completed year of service with the Corporation, plus a retiring allowance of fifteen-sixtieths of the said annual average salary in respect of a period of previous municipal service in Hull, provided that the said retiring allowance shall not exceed one-half of said annual salary; (3) that he shall pay over to the Corporationu the sum of £255 17s. 9d., being the amount contributed by him to the Superannuation Fund established by Hull Corporation under the Local Government and other Officers' Superannuation Act, 1922; (4) that he shall contribute 5 per cent. of his salary towards said retiring allowance, which contribution shall be made monthly by way of deduction from his salary; and (5) that, in the event of his resignation, dismissal, or death before becoming entitled to a retiring allowance, the Corporation shall pay to him or to his widow or family or legal representative, if any, as the case may be, a sum equal to the amount of his contributions without interest, and also the sum of £255 17s. 9d. referred to in condition 3. It was moved as an amendment that consideration of the question of superannuation be delayed meantime and that Mr. Bell be asked to state if he would be prepared to accept the appointment of general manager on the conditions mentioned other than superannuation. On a vote, 11 members voted for the motion and seven for the amendment.

Glasgow Corporation, on August 9th, by 47 votes to 32, with two members declining to vote, approved of the terms and conditions in connection with the appointment of Mr. HERBERT BELL as general manager of the Electricity Department and as recommended by the Electricity Committee.

It was announced last week that Sir EDWARD T. F. CROWE, C.M.G., has been appointed Comptroller-General of the Department of Overseas Trade, in succession to Sir William Clark, who has been appointed High Commissioner in

[F. A. Swaine.

Sir Edward T. F. Crowe, C.M.G.

Canada. Sir Edward vacates the position of Director of the Foreign Division of the D.O.T., to which Mr. J. PICTON BAGGE, Commercial Secretary at Brussels, has been appointed. Mr. Picton Bagge's successor at Brussels is Mr. N. S. REYNTIENS, O.B.E.

Liverpool City Council has approved the following appointments due to the reorganisation of the staff of the electricity supply department:—Mr. L. BREACH, senior engineering assistant, is appointed chief electrical assistant, at a salary of £750 per annum; Mr. H. MIDGLEY, chief assistant mechanical engineer, is appointed chief technical assistant, at a salary of £750 per annum; Mr. M. H. WARDLE, principal assistant in the lighting department, is appointed chief assistant, at a salary of £550 per annum; Mr. E. L. MORLAND, distribution engineer, is appointed superintendent engineer of distribution, at a salary of £900 per annum; Mr. J. H. MURRAY, h.p. mains engineer, is appointed distribution engineer, at a salary of £400 per annum; Mr. C. L. EAGLE, l.p. mains superintendent, is appointed assistant distribution engineer at a salary of £375 per annum; Mr. J. G. JONES, superintendent jointer, is appointed mains superintendent, at a salary of £375 per annum; Mr. J. STIRRUP, superintendent meter department, is appointed consumers' engineer, at a salary of £600 per annum: Mr. W. MAYHEW, assistant engineer, is appointed assistant high-pressure engineer, at a salary of £375 per annum; Mr. S. LOWEY, installation engineer, is appointed assistant consumers' engineer, at a salary of £400 per annum; Mr. J. HAMILTON, station superintendent, is appointed superintendent engineer of generation, at a salary of £900 per annum; Mr. H. A. W. WILLIAMS, turbine house superintendent, is appointed station superintendent, at a salary of £525 per annum; Mr. K. M. FERGUSSON, maintenance engineer, is appointed assistant boiler-house superintendent, at a salary of £450 per annum, Mr. H. W. JONES, M.Eng., superintendent engineer in charge, Lister Drive No. 3 station, is appointed generation superintendent, at a salary of £450 per annum; Mr. G. A. THOMPSON, assistant engineer in charge, Lister Drive No. 3 station, is appointed superintendent engineer in charge, Lister Drive No. 3 station, at a salary of £350 per annum; Mr. H. J. LAMDEN, battery superintendent, is appointed assistant electrical engineer; Mr. C. H. HALL, assistant sub-station engineer, is appointed battery superintendent.

The Stockport Town Council has made the following appointments on the promotion of Mr. OLDROYD as deputy electrical engineer: Mr. W. R. ALLCOCK, power station superintendent; Mr. E. A. GLEAVES, assistant power station superintendent; Mr. V. FOSTER, charge engineer; and Mr. J. BALL, assistant charge engineer.

Mr. H. C. EYLES, of the staff of the Sheerness and District Electric Power Co., Ltd., who was married recently to Miss Dorothy Nichol, has been presented by his colleagues with a canteen of cutlery.

The following notice is a little unusual, but it is interesting and distinctly human, so we gladly give it publicity:—Mr. FRANK WM. LARTON, for many years Yorkshire representative for Premier Electric Heaters, Ltd., of Birmingham, is now proprietor of "The White Horse Hotel," Armley and Wellington Road, Leeds, where he will be pleased to welcome his many friends in the electrical trade.

Mr. WILLIAM E. FLETCHER, of Pritchett & Gold & E.P.S. Co., Ltd., with which is incorporated the business of Peto and Radford, asks us to state that his private address is now 5, St. Oswalds Road, Small Heath, Birmingham.

On the occasion of his marriage to Miss G. M. SMITH, Mr. GEORGE HAMBLIN, of the staff of the Wrexham Corporation Electricity Department, has been presented by his colleagues with a clock.

Obituary.—MR. A. WILLMOTT.—We regret to record the death of Mr. Arthur Willmott, A.M.I.E.E., M.I.P.E., who passed away from heart failure on August 10th after a short illness. For many years he was works manager of the Electric Ordnance and Accessories Co., and later filled a similar position with Lyons & Wrench, and the Igranic Electric Co., Ltd. Mr. Willmott was a member of the Engineers' Club, and was particularly well known in electrical circles in the Midlands. The funeral and interment took place on Wednesday at Worcester.

MR. W. A. CHAMEN.—It is with feelings of very deep regret that we learn, as we go to press, that Mr. W. A. Chamen, M.I.M.E., M.I.E.E., late engineer and general manager of the South Wales Electrical Power Distribution Co., passed away on Monday evening last. The interment and memorial service were to take place yesterday (Thursday).

DR. C. CHREE.—We learn with regret that Dr. Charles Chree, D.Sc., F.R.S., who for 32 years was superintendent of Kew Observatory, died on Sunday last at Worthing, aged 68 years. Distinguished in his university career at Aberdeen, he obtained further honours at Cambridge, where for many years he held a Fellowship at King's College, until in 1893 he assumed control of the Kew Observatory, eventually becoming a world-famed authority on terrestrial magnetism and atmospheric electricity. He was the author of many papers and articles on these and other branches of science, and was awarded the Hughes Medal of the Royal Society in 1919. He was a past-president of the Physical Society and of the Royal Meteorological Society.

Wills.—The *Financial Times* states that Mr. DAVID REID, of Benvue, Busby, Lanarkshire, electrical engineer, largely interested in Kelvin Bottomley & Baird, and formerly managing director of Kelvin & James White, left personal estate in Great Britain valued at £45,851.

Mr. C. A. KNIGHT, described as a consulting engineer and lately a director of Babcock & Wilcox, Ltd., left £309,488 gross and £307,928 net personalty.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Argentine Industrial Co., Ltd.—Registered as a public company on August 4th, with a nominal capital of £200,000 in £1 shares. The objects are to acquire the whole undertaking of the South American Light & Power Co., Ltd. (in liquidation), to acquire and hold securities and investments, &c. The directors (to number not less than two nor more than five) are:—J. P. Clarke, 89, Hyde Park Gate, S.W.7, civil engineer; H. C. Allen, Holy Well, Hook Heath, Woking, chairman of Buenos Aires Great Southern Railway Co., Ltd.; R. Tristram Harper, 7, Thorney Court, Hyde Park Gate, W.8, chartered accountant. Qualification, £300 shares. Remuneration, £1,000 per annum, divided. Registered office: River Plate House, Finsbury Circus, E.C.

Classic Radio and Gramophone Co., Ltd.—Private company. Registered August 4th. Capital, £2,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in all kinds of wireless apparatus, gramophones, &c. The subscribers (each with one share) are:—H. A. Foster, 44, Shaw Villas, Holloway, N.7, clerk; W. A. Peters, 54, Livingstone Road, Clapham Junction, S.W.11, clerk. The first directors are to be appointed by the subscribers. Qualification (except first directors), £500. Solicitors: Soames, Edwards and Jones, Lennox House, Norfolk Street, Strand, W.C.2.

Great Asby Electric Light and Water Co., Ltd.—Private company. Registered August 10th. Capital, £2,000 in £5 shares. Objects: To carry on business as indicated by the title. The directors are:—Robert Salkeld, Green Banks, Great Asby, Appleby, Westmorland, club manager and secretary; W. Sowerby, River View Farm, Great Asby, farmer; W. Alderson, Catherine Holme, Great Asby, farmer; R. Bell, Water Houses, Appleby, farmer; J. Donald, Woodleigh, Kirkby Stephen, electrical engineer; R. R. Sowerby, Winton House, Kirkby Stephen, solicitor. Secretary: Ronald F. Salkeld. Registered office: Green Banks, Great Asby, Appleby.

Nantwich Electric, Ltd.—Private company. Registered August 1st. Capital, £500 in £1 shares. Objects: To acquire the business of an electrical engineer and contractor carried on by B. Nadin, at 3, Hospital Street, Nantwich, as "Nantwich Electrical Co." The subscribers (each with one share) are:—B. Nadin, 3, Hospital Street, Nantwich, electrical engineer; J. George, 4, Church Lane, Nantwich, jeweller. Secretary: B. Nadin. Registered office: 3, Hospital Street, Nantwich, Cheshire.

New Standard Wireless Valve Co., Ltd.—Private company. Registered August 9th. Capital, £500 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in wholesale and retail wireless thermionic valves, radio apparatus, electric lamp bulbs, &c. The directors are:—H. Worrall, 13, Pinfold Street, Macclesfield; H. Shepherd, Ecuador Villa, Ickenham Close, Ruislip; W. Shephard, 33, Adlington Road, Bollington, Macclesfield. Secretary: W. Shephard. Solicitor: H. G. Barclay, Exchange Chambers, Macclesfield, Cheshire.

Daventry & Co., Ltd.—Private company. Registered August 9th. Capital, £1,000 in £1 shares. Objects: To carry on the business of wireless, telephone and telegraph engineers, manufacturers of wireless apparatus, &c. The permanent directors are:—J. Brocklehurst, 5, Grosvenor Place, Ashton-on-Ribble, Preston, manufacturers' agent; A. A. Brocklehurst, St. James' Chambers, Waterfoot, architect and surveyor; G. Makin, 2, Highfield Drive, Penwortham, Preston, wireless factor. Qualification: 50 ordinary shares. Registered office: Mellings Yard, Friargate, Preston.

Drury Radio Co., Ltd.—Private company. Registered August 9th. Capital, £2,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in instruments, accessories, literature, &c., connected with radio telegraphy, telephony or television, also gramophones, &c. The directors are:—Fred P. Bolton and F. Paulson, both of 111, Wellington Road, New Brighton, Cheshire. Secretary: Florrie Bolton. Registered office: Drury Buildings, 23, Water Street, Liverpool.

British Sousedik Electric Motors, Ltd.—Private company. Registered in Edinburgh on August 7th. Capital, £100 in £1 shares. Objects: To carry on the business of electricians, mechanical and general engineers, &c. The subscribers (each with one share) are:—G. F. Fennick, 135, Buchanan Street, Glasgow, law clerk; J. M. Clark, 135, Buchanan Street, Glasgow, law clerk. Secretaries: Clark & Cameron. Registered office: 135, Buchanan Street, Glasgow.

Official Returns of Electrical Companies.

Urban Electric Supply Co., Ltd.—Return dated May 24th, 1928. Capital at date of return: £640,000 in 240,000 ordinary, 350,000 preference, and 50,000 unclassified shares of £1 each (increased to £800,000 on May 30th, 1928 by the creation of 160,000 new ordinary shares of £1 each). 240,000 ordinary and 350,000 preference shares taken up. £490,000 paid on 240,000 ordinary and 250,000 preference shares. £100,000 considered as paid on 100,000 preference shares. Mortgages and charges, £350,000 5½ per cent. debenture stock and £220,979 4½ per cent. debenture stock. Return of allotments, made up to June 14th, 1928, shows a further 160,000 ordinary shares allotted as fully paid by way of bonus to ordinary shareholders.

Sudan Light and Power Co., Ltd.—Capital, £356,000 in £1 shares. Return dated October 12th, 1927. 354,500 shares taken up. £232,126 15s. paid (being £1 per share on 5,007, 15s. per share on 299,493, and 1s. per share on 50,000 shares). Mortgages and charges, £385,000. Return of allotments, made up to March 23rd, 1928, shows a further 1,500 shares allotted, payable in cash, and fully called up.

George H. Scholes & Co., Ltd.—Capital, £8,000 in £1 shares (5,000 preference and 3,000 ordinary). Return dated August 30th, 1927 (filed May 25th, 1928). 2,336 preference and 2,002 ordinary shares taken up. £1,952 paid on 1,950 preference and 2 ordinary. £2,386 considered as paid on 386 preference and 2,000 ordinary. Mortgages and charges, nil.

Hexham and District Electric Supply Co., Ltd.—Capital, £35,000 in 7,605 "A," 6,479 "B," and 20,916 "C" shares of £1 each. Return dated April 2nd, 1928. All shares taken up. £28,521 paid. £6,479 considered as paid. Mortgages and charges, £26,000.

Bude Electric Supply Co., Ltd.—Capital, £15,000 in £1 shares. Return dated May 29th, 1928. 14,114 shares taken up. £11,133 7s. 6d. paid (being £1 per share on 10,000 and 2s. 6d. per share on 4,114 shares, including payments in advance). Mortgages and charges, £2,500.

Ebonite Container Co., Ltd.—Satisfaction in full on July 25th, 1928, of charge dated November 10th, 1926, securing amounts not exceeding £7,500, which the chargees may pay to Barclays Bank, Ltd., and for securing payment of a yearly sum under an agreement of even date.

British Electrical Instruments, Ltd.—Capital, £1,000 in £1 shares. Return dated December 29th, 1927 (filed March 10th, 1928). All shares taken up. £1,000 paid. Mortgages and charges nil.

Lathartone, Ltd.—Capital, £5,000 in 2,000 preference and 3,000 ordinary shares of £1 each. Return dated June 21st, 1928. 50 preference and 3,000 ordinary shares taken up. £3,050 paid. Mortgages and charges nil.

Acme Electric Lamp Co., Ltd.—Capital, £1,000 in £1 shares. Return dated June 22nd, 1927 (filed March 1st, 1928). All shares taken up. £2 paid. £998 considered as paid. Mortgages and charges, £1,251.

London Platino-Brailian Telegraph Co., Ltd.—Capital, £400,000 in £10 shares. Return dated May 24th, 1928. 37,480 shares taken up. £374,800 considered as paid. Mortgages and charges, nil.

St. Helens Cable and Rubber Co., Ltd.—Capital, £100,000 in £1 shares. Return dated March 14th, 1928. 84,000 shares taken up. £84,000 paid. Mortgages and charges nil.

J. S. Ramsbottom & Co., Ltd.—Capital, £1,000 in £1 shares. Return dated June 26th, 1928. All shares taken up. £500 (10s. per share) paid in cash. Mortgages and charges nil.

Sheringham and District Electricity Supply Co., Ltd.—Capital, £2,000 in £1 shares. Return dated May 28th, 1928. 400 shares taken up. £400 paid. Mortgages and charges nil.

New Radnor Electric, Ltd.—Capital, £650 in £1 shares. Return dated May 16th, 1928. 632 shares taken up. £600 paid. £32 considered as paid. Mortgages and charges nil.

Tungsram Electric Lamp Works (Great Britain), Ltd.—Capital, £100 in £1 shares. Return dated June 19th, 1928. 10 shares taken up. £10 paid. Mortgages and charges nil.

Nathan & Allen, Ltd.—Capital, £10,000 in £1 shares. Return dated July 2nd, 1928. 3,450 shares taken up. £1,100 paid. £2,350 considered as paid. Mortgages and charges nil.

Dolywern and District Electricity Supply Co., Ltd.—Capital, £1,000 in £1 shares. Return dated May 19th, 1928. 500 shares taken up. £500 paid. Mortgages and charges, nil.

Callington and District Electric Supply Co., Ltd.—Satisfaction in full on May 30th, 1928, of debentures dated August 27th, 1926, and April 27th, 1927, securing £1,000

Radio Service (London), Ltd.—Satisfaction to the further extent of £125 on July 15th, 1928, of debentures dated July 25th, 1927, securing £2,750.

City Notes.

East African Power and Lighting Co., Ltd.

This company, which was to hold its annual meeting at Nairobi Kenya Colony, on Wednesday, August 15th, reported, according to the financial Press, that the gross revenue for the year 1927 from the sale of current expanded from £48,398 (1926) to £60,838. The total profits were £67,278, as against £53,100 for the previous year, and the net revenue was £41,101 against £33,509. After paying £9,094 interest, putting to reserve £6,263, and to depreciation £9,042, a dividend of 6 per cent. on the ordinary (as against 5 per cent.) was recommended. The 7 per cent. three-year secured registered notes, amounting to £160,000, were redeemed on June 30th, 1927, and in December last an issue of 270,000 7 per cent. cumulative preference shares of 20s. each was made. The proceeds of this issue have been applied in repayment of the moneys advanced by bankers for redemption of note issue and balance is available for extension of company's system.

Stock Exchange Notices.

Dealings in the following have been specially allowed by the Committee under Rule 159:—

Bridgwater and District Electric Supply and Traction.—50,000 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 2,658 to 52,657.

Electramonic (Foreign Rights).—400,000 ordinary shares of 5s. each, partly paid and fully paid, Nos. 1 to 400,000.

Berry's Electric (1928), Ltd.—£100,000 7½ per cent. (20-year) cumulative convertible notes of £100 each partly paid and fully paid, Nos. 1 to 1,000 (registered).

Davis & Timmins. Ltd.—10,000 ordinary shares of £1 each fully paid, Nos. 157,001 to 167,000.

Application has been made to the Committee to allow the following to be officially quoted:—

Hungarian Trans-Danubian Electrical Co., Ltd.—£2,300,000 6½ per cent. "B" debenture stock.

Delhi Electric Supply and Traction Co., Ltd.—20,000 shares of £1 each fully paid, Nos. 130,001 to 150,000.

Postal Telegraph and Cable Corporation.—£9,201 5 per cent. collateral trust debenture stock and fractional scrip certificates.

Underground Electric Railways Company of London, Ltd.—10,416 ordinary shares of £1 each fully paid, Nos. 5,540,436 to 5,559,851.

Compania de Electricidad de la Provincia de Buenos Aires.

The report of this company for the year 1927, states, says the *Financial Times*, that, after deducting from working profits general expenses, directors' and trustees' fees and taxes in Europe, debenture interest, sinking fund for redemption of bonds, interest, commissions and difference in exchange, and after adding profit on bonds purchased for redemption, the net profits amount to £165,631. It is proposed to place to reserve fund £8,281. to directors £15,735, to reserve fund as per article 111 (further allocation) £71,767, dividend of 8 per cent. on pre-preference shares and dividend of 8 per cent. on preference shares. The 350,000 new preference shares of £1 created in 1926 were issued at the beginning of 1927. Sums paid as commission and other expenses in connection with issue of those shares, amounting in total to £82,622, have been written off entirely, debiting them to reserve account created in accordance with article 111.

Oxford Electric Co., Ltd.

Interim dividend of 7 per cent. per annum, less tax. on the ordinary shares for the half-year.

Edmundsons' Electricity Corporation, Ltd.

The holders of the 4½ per cent. first mortgage debenture stock were notified under date August 10th that in accordance with Clause 4 of the Supplemental Trust Deed of August 13th, 1908, the company will, on November 15th, 1928, redeem the whole of this stock outstanding at the rate of £105 for every £100 of stock. Accrued interest will be paid at date of redemption.

Welsbach Light Co., Ltd.

According to the financial papers, the directors state that assents to the offer of Imperial Chemical Industries exceeding the stipulated minimum of 76 per cent. have been received from Welsbach shareholders, and that the offer has therefore become absolute and binding.

Waste Heat and Gas Electrical Generating Stations, Ltd.

Interim dividend of 2½ per cent., less tax.

Stocks and Shares.

MONDAY EVENING.

LIVELY public interest is concentrated upon the outlook for cable stocks and shares, in view of the merger, and the figures which have been published in connection with the proposed financial arrangements. Holders of the existing stocks and shares are inclined to ask, with a touch of exasperation, how it is that prices have not gone ahead, instead of having fallen back from the recent high levels touched. Eastern Telegraph ordinary, for instance, after being 250, has gone back to 245; and the shares of the three associated companies—Globe Telegraph and Trust, Eastern Extension, and Western—have reacted to 24½ in similar fashion.

The Halt in Cable Stocks.

The reason is that the expected has happened, and people who bought the shares at considerably lower figures on the anticipation of what has now actually come to pass, are taking their profit, on the theory that there is nothing much left to go for in the immediate future, and that the time is propitious for accepting prices which are very satisfactory when compared with the purchase prices of the same shares. Numbers of people have got profits ranging from £5 to £10 a share, and of 50 to 100 points in the case of Eastern Telegraph stock, and it is not at all surprising that many of these investors, recognising the ever-present possibility of that slip 'twixt cup and lip which is liable to occur in financial affairs, are making sure of their profit, and re-investing the money in gilt-edged securities. It is possible to work out statistically, as we have shown on a previous occasion, that Eastern ordinary should be worth anything between 270 and 300, and that the shares of the other companies are worth, on paper, 27 to 30, but a pause has been called to the upward movement, and it is natural enough that, in the circumstances, the speculative investor should be willing to take so handsome a gain on his original purchase price.

Wireless.

Marconi shares are a dullish market. On the published details, it is contended that Marconi shares at the current figure stand higher, relatively, than do the stocks and shares of the cable group which is to be linked with the Marconi Company. Here also, however, the real cause for the dulness is probably due to the simple fact that there is nothing very much which can be seen in the immediate future. Consequently prices tend to sag. The £1 shares have gone back to 4½, as compared with 65s. for the 10s. shares—a discrepancy which must puzzle more than ever those who maintain that the relationship between the two classes should be exactly double, and that the £1 shares are worth twice as much as those of the 10s. denomination. Marconi Marines show renewed strength, and a rise to 51s.

Rise in Underground Bonds.

The Home Railway market is better, with a sharp rise in Underground income bonds as an outstanding feature. The shares have improved to a corresponding extent. A little support came in at the end of last week, and buyers who cannot get the offer of what they require, either of the shares or of the debentures, will buy the other sort if possible, because the income bonds are convertible into shares. Metropolitan Consolidated is firm on the announcement that the company did record business on August Bank Holiday, and Districts are a point to the good at 77.

Home Electricity.

In the market for Home electricity supply and power shares, one feature is the jump to 5s. premium in Scottish Power new ordinary, which, it will be remembered, came out at 26s., and which for some time remained about 2s. 6d. premium. The stags have now been disposed of, and this is the reason why the price has gone ahead, for buyers have found holders of the shares very averse from parting from their interests, the idea being that the company has sufficient scope for future development to render the shares a sound industrial investment. St. James' and Pall Mall 3½ per cent.

debenture is 3 points up at 70. Midland Electric Power Corporation advanced sharply on a little support, the price strengthening to 43s. 9d. Bournemouth and Poole are also a good market, and there has been a marked amount of strength in other provincial light and power issues. Edmundsons 4½ per cent. debenture rose from 90 to 102½, on the board's decision to pay off the stock at 105. Folkestone 4½ per cent. and Isle of Wight 4½ per cent. debenture stocks each rose several points, to 86.

High-priced Preferences.

London Electrics are the only shares in their particular group which have moved during the present week, and at 27s. 6d. show a gain of a few pence. It may be pointed out that a number of preference shares in the London Electricity Supply Company's group now yield very little more than the return afforded by investment in a good many trustee securities. It seems to us a graceful compliment to the direction of companies whose shareholders are content to keep their money in preference shares upon which the yield at the present quotations is so comparatively small; it shows that solid investment regards this class of share as being equally as good as many of the stocks which figure in the Colonial Government lists, for instance, where the return is a trifle over 5 per cent. on the money.

To take one or two examples, County of London 6 per cent. preference at 23s. 6d. return £5 2s. 2d. per cent., and City of London preference come into the same line. Charing Cross preference at 17s. 6d. pay a few pence more, namely, £5 2s. 10d. per cent. Metropolitan 4½ per cent .preference the same. The shares are so extremely well held that few come to market, and it is doubtful whether a buyer could supply himself at the figures given in our list, which are the middle Stock Exchange prices. He would probably have to give prices at which the return on the money would be no more than 5 per cent. No one can challenge the security or the soundness of such shares as these, but in view of the possibility that money may become a little stiffer during the autumn, and thereby affect quotations for gilt-edged and what are called "money" stocks, it may be thought that the present range of prices for such preference shares as those we have mentioned, is sufficiently high.

Brazil Tractions: Hydro Electrics.

Brazilian Tractions have risen another 4 points to 56½, but a sudden drop occurred in Hydro-Electrics, where the price went back to 26, leaving it 3½ down on the week. International Holdings have gone back to 11½, being somewhat pressed for sale by foreign and Colonial holders. Canadian utility stocks and shares have been dwindling by reason of a report that financial difficulties have arisen in certain of the Canadian cities as an effect of the over-speculation that reflected the American boomlet of a couple of months ago. and which was followed by a speedy drop in the principal speculative counters. Bermuda Traction debenture hardened to 4½ discount, and the shares rose 1/16 to 12s. 6d. The Mexican group is quiet, and no changes have occurred. Anglo-Argentine Tramways 5 per cent. debenture stock strengthened to 78½, the yield on the money at the present price attracting the attention of the speculative investor, but the second preference shares at 70s. are ¼ down. Montreal Light and Power regained a couple of points, to 104. An inquiry for Georgia Light and Power First Lien bonds lifted the price to 107½. The last-recorded transaction took place eleven months ago at 97½. The company's common shares changed hands six weeks back at 60½.

Competition with Motors.

Cape Electric Tramways gave way to 13s. 9d. On the other hand, there is a little demand for London traction issues, on the impression that motor and charabanc competition in this country is very near its zenith. Private motoring has lost a good deal of its attraction because of the congested state of the roads. Energetic steps are being taken by railway and other public companies to meet the enterprise of charabanc and motor transport. Meanwhile the omnibuses are fitting pneumatic in the place of solid tires, and rubber shares are rising in price at the prospect of rubber consumption keeping pace with supply, even when the restriction upon the latter is removed on November 1st next. Manufacturing companies' shares present a firm front. Metropolitan-Vickers ordinary are 1s. 9d. up, at 32s. 6d. The dull spot in this group is provided by Telegraph Constructions, which, at 24½, show a fall of half-a-sovereign.

Foreign Telephones.

United River Plate Telephones are 5s. lower at 9½, uneasiness being felt as to the outcome of the negotiations, over charges, with the Argentine Government. Cuba Telephone 5 per cent. first mortgage debenture eased off to 97½. A modest parcel of Siemens 4½ per cent. debenture stock was readily placed at 92½. There is on offer a few thousand pounds Postal Telegraph and Cable Corporation 5 per cent. debenture stock, which can be obtained at 97½ or thereabouts. Bogota Telephone ordinary shares are quoted at 33s., the new ordinary, fully-paid, being about 3s. less. Both classes of Venezuela Telephone, ordinary and 8 per cent. participating preference, stand at 24s. 6d. for each.

Share List of Electrical Companies.

	Nom.	Dividend. 1926.	Dividend. 1927.	Price Aug. 13, 1928.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	£1	14†	15	3 1/16	—	... ...
Brompton Ordinary	£1	8⅝	8½	26/6	—	5 5 8
Charing Cross Ordinary	£1	8½	8½	27/-	—	5 3 8
do. do. 4½% Pref.	£1	4½	4½	17/6	—	5 2 10
Chelsea	£1	8⅝	8⅝	26/6	—	5 5 8
City of London	£1	10	10	20/9	—	4 11 1
do. do. 6% Pref.	£1	6	6	23/6	—	5 2 2
Clyde Valley	£1	8	8	37/-	—	4 6 3
County of London	£1	7½	7½	38/-	—	3 19 3
do. do. 6% Pref.	£1	6	6	23/6	—	5 2 2
Edmundsons' 7% Pref.	£1	7	7	25/6	—	5 9 10
Elec. Supply Corporation	£1	11	11	47/6	—	4 12 7
Kensington Ordinary	£1	8	8	26/6	—	5 5 8
Lancs. Light and Power	£1	7½	7½	29/-	—	5 3 5
London Electric	£1	8½	8½	27/6	+6d.	5 1 10
Metropolitan	£1	8	9	2⅝	—	3 16 0
do 4½% Pref.	£1	4½	4½	17/6	—	5 2 10
Midland Counties	£1	6	6½	30/-	—	4 6 8
Mid. Elec. Power	£1	—	15	43/9	+4/6	... ...
Newcastle-on-Tyne Ordinary	£1	5	6	25/-	—	4 16 0
do. 7% Pref.	£1	7	7	26/6	—	5 5 8
Notting Hill 6% Pref.	£10	6	6	10⅝	—	5 11 7
North Met. Elec. 6% Pref.	£1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	£5	8	8	27/6	—	5 1 10
Scottish Power	£1	8	8	31/6	+6d.	5 1 7
South London	£1	8½	8½	26/6	—	5 5 8
Urban Ordinary	£1	7	7	31/3	—	... ...
Westminster Ordinary	£1	8½	8½	27/6	—	5 1 10
Whitehall Elec. Invst. 7½% Pref.	£1	7½	7½	24/-	—	6 5 0
Yorkshire Elec.	£1	8	8	35/-	—	4 11 5
Home Rails.						
Central London Ord. Assented	Stock	4	4	78	—	5 9 7
Metropolitan	,,	3	3	67½	—	4 9 0
do. District	,,	3½	4	77	+1	5 4 0
Underground Electric	£1	1½	5	26/-xd	+6d.	3 17 0
do. do. Income	Bonds	6	6	127	+3	4 14 6
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	100½	—1	5 19 5
do. Def.	,,	1½	1½	24	—	6 5 0
Automatic Telephone	£1	10	10	43/9	—	4 9 0
Eastern Extension	£10	10	10	24½	—½	*4 1 8
Eastern Tel. Ord.	Stock	10	10	245	—5	*4 1 8
Globe Tel. and T. Ord.	£10	10	10	24½	—½	*4 1 8
do. do. Pref.	£10	6	6	11⅛	—	5 7 10
Great Northern Tel.	£10	20	20	38	—	5 5 3
Indo-European	£5	10	10	45½	—	*5 10 0
Marconi	£10/-	5	*10	3½	—	... ...
Marconi-Marine	£1	8½	12½	51/-	+1/-	4 18 1
Oriental Telephone Ord.	£1	12	12	53/9	—	*4 9 3
United R. Plate Tel.	£5	8	8	9½	—½	*4 2 1
Western Telegraph	£10	10	10	24½	—½	4 1 8

*Interim.

Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref.	£5	5½	5½	8⅜	—	7 11 9
do. do. 2nd. Pref.	£5	6	6	8½	—½	8 11 6
do. do. 5% Deb.	Stock	5	5	78½	+1	6 7 5
British Electric Traction Def. Ord.	,,	—	—	520	—	... ...
do. do. Pref. Ord.	,,	8	7½	125	—1	6 0 0
Brazil Traction	£100	6	7	56¼	+4	3 2 0
Brit. Colombia Elec. Rly. Pcc.	Stock	5	5	90⅝	—	5 3 9
London & Sub. Trac. 5% Pref.	£1	Nil	Nil	10/6	—	... ...
London United Tram Deb.	Stock	4	4	60½	—	6 12 3
Mexico Trams, 5% Bonds	—	5	5	81	—	6 3 3
Mexican Light Common	100	Nil	Nil	71	—	... ...
do. 7% Pref.	100	Nil	7	77½	—	9 0 8
do. 1st Bonds	—	5	5	80½	—	6 4 3
Yorkshire (West Riding)	£1	Nil	Nil	5/-	—	... ...
Manufacturing Companies.						
Babcock & Wilcox	£1	13	15	67/6	—	*4 9 0
British Aluminium Ord.	£1	10	10	42⅜	—	*4 11 6
British Elec. Transformer Pref.	£1	7	7	18/-	—	7 15 0
British Insulated Ord.	£1	15	15	4½	—	3 10 6
Brush Ord.	£1	10	10	28/3	—	7 2 10
Callenders	£1	15	15	4½	—	3 12 6
do 6½% Pref.	£1	6½	6½	23/9	—	5 9 5
Crompton Parkinson Pref Ord.	£1	—	6	17/6	—	6 17 2
do. 8% Pref.	£1	—	8	26/3	—	6 2 0
Edison-Swan	£/-	10	10	12/6	—	3 4 0
do. 5% Deb.	Stock	5	5	88	—	5 13 8
Electric Construction	£1	7½	7½	27/6	—	5 9 1
Enfield Cable Pref.	£1	7½	7½	26/3	—	5 14 3
English Electric	£1	Nil	Nil	7/6	—	... ...
do. do. Pref	£1	3	Nil	10/-	—	... ...
Gen. Elec. Pref.	£1	6½	6½	24/6	—	5 6 1
do. Ord.	£1	7½	10	38/6	—	5 4 0
Henley	£1	25	25	5⅝	—	4 9 0
do. 4½% Pref.	£5	4½	4½	4½	—	5 6 0
India-Rubber	£1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	£1	12½	10	2	—	5 0 0
Met.-Vickers Ord.	£1	8	6	32/6	+1/9	3 13 10
do. Pref.	£2	8	8	2⅝	—	6 1 11
Siemens Ord.	£1	7½	7½	27/6	—	5 9 1
Telegraph Construction	£12	10	10	24½	—½	*4 18 6

*Dividends paid free of Income Tax.

† 4% of which was Tax Free.

Italian Foreign Electrical Trade.

Imports and Exports in 1926 and 1927.

THE following statement, showing the imports into and exports from Italy of electrical goods during 1927 has been compiled from the recently-issued official trade statistics. The figures for 1926 are added for purposes of comparison and notes of any increases or decreases are made :—

Imports.

	1926. Quintals.	1927. Quintals.	Inc. or dec. Quintals.
Electric generators and motors—			
Total	38,000	22,000	−16,000
From Austria	1,200	900	− 300
„ Germany ...	19,000	7,500	−11,500
„ Great Britain ...	700	700	—
„ Switzerland ...	4,200	2,600	− 1,600
„ Hungary ...	5,000	2,000	− 3,000
„ United States ...	2,000	1,900	− 100
Static transformers—			
Total	7,000	4,500	− 2,500
From Austria	100	200	+ 100
„ Germany ...	3,000	2,000	− 1,000
„ Germany (Reparation account)	500	500	—
„ United States ...	100	20	− 80
Electricity meters—			
Total	6,500	3,400	− 3,100
From Germany ...	5,000	3,000	− 2,000
„ Switzerland ...	900	200	− 700
**Telegraph and telephone apparatus—*			
Total	6,200	6,400	+ 200
From Germany ...	4,000	3,200	− 800
„ Germany (Reparation account)	30	30	—
„ United States ...	330	400	+ 70
„ Belgium ...	500	900	+ 400
Carbons, electric—			
Total	37,000	32,000	− 5,000
From Germany ...	18,000	18,000	—
„ Jugo-Slavia ...	1,500	1,000	− 500
„ United States ...	15,000	11,000	− 4,000
Insulators, porcelain, &c.—			
Total	9,000	5,800	− 3,200
From Germany ...	3,600	2,600	− 1,000
„ United States ...	1,400	—	− 1,400
„ France	3,000	2,400	− 600
Accumulators—			
Total	800	850	+ 50
Other electrical apparatus and parts—			
Total	15,000	16,000	+ 1,000
From France	2,800	3,300	+ 500
„ Germany ...	8,000	7,200	− 800
„ Germany (Reparation account)	270	400	+ 130
„ Switzerland ...	1,100	1,300	+ 200
„ United States ...	1,500	1,000	− 500
„ Great Britain ...	200	1,000	+ 800
Electric lamps—			
Total (thousands)	16,400	14,200	− 2,200
From Austria	1,500	1,800	+ 300
„ Germany ...	4,800	4,666	− 134
„ Holland ...	8,600	6,019	− 2,581
„ Switzerland ...	27	187	+ 160
„ Hungary ...	1,200	1,347	+ 147
Insulated electric wire or cable, covered with rubber or textiles	1,700	2,000	+ 300
Ditto, armoured, including submarine cables	2,400	4,000	+ 1,600

* Including radio apparatus 1,600 q. in 1926 and 1,500 q. in 1927.

Exports.

	1926. Quintals.	1927. Quintals.	Inc. or dec. Quintals.
†*Insulated electric wire or cable, covered with rubber or textiles* ...	5,300	3,700	− 1,600
†*Ditto, armoured, including submarine cables*	35,000	27,000	− 8,000
Electric generators and motors—			
Total	23,700	22,900	− 800
To Belgium	900	530	− 370
„ France	1,400	3,200	+ 1,800
„ Spain	1,300	1,100	− 200
„ India	3,200	5,000	+ 1,800
„ Argentina	3,600	4,400	+ 800
„ Brazil	3,300	2,700	− 600
Static transformers ...	3,200	1,700	− 1,500
Accumulators	2,200	2,100	− 100
Magnetos	400	200	− 200
Electricity meters	95	210	+ 115
Telegraph and telephone apparatus	580	350	− 230
Radio apparatus	800	400	− 400
Insulators, porcelain, &c.	510	490	− 20

† Principal destinations: Argentina, United States, Rumania, and Brazil in 1926, and Argentina, Peru, Spain, Brazil and Cuba in 1927.

Swiss Federal Railway Electrification.

Some Particulars of the Vernayaz Hydro-electric Power Station.

THE Vernayaz plant forms part of the group of hydro-electric stations supplying the power for the electrified lines of the Swiss Federal railways, and is the most important of the different installations. The station, which is located at the foot of the steep mountain slopes near the village of Vernayaz, in the Lower Valais Canton, utilises the water of the Rivers Eau Noire and Trient, as well as of a large artificial lake formed at the head of the Barberine valley. When fully completed, the plant, which works under a head of 2,000 ft., will consist of six generator sets, *viz.*, five 19,300-h.p. turbines coupled to 11,000/14,000-kVA single-phase generators, and one turbine driving an 11,000-kVA single-phase alternator on one side, and a 14,000-kVA 3-phase generator on the other, the latter being intended for the supply of power to private works in the neighbourhood. So far only four of the units have been installed, and the three-phase generator and two of the single-phase machines have been supplied by the Oerlikon Co.

The 11,000-kVA single-phase generators are designed to provide a peak load of 17,100 kVA for ten minutes and 14,000 kVA for 1½ hours; they run at 333⅓ revs. per min., and generate at 16⅔ periods and 15,000 volts. The specification called for a power factor of 0.75 with a corresponding efficiency of 92.7 per cent. at full load and 89.2 per cent. at half load.

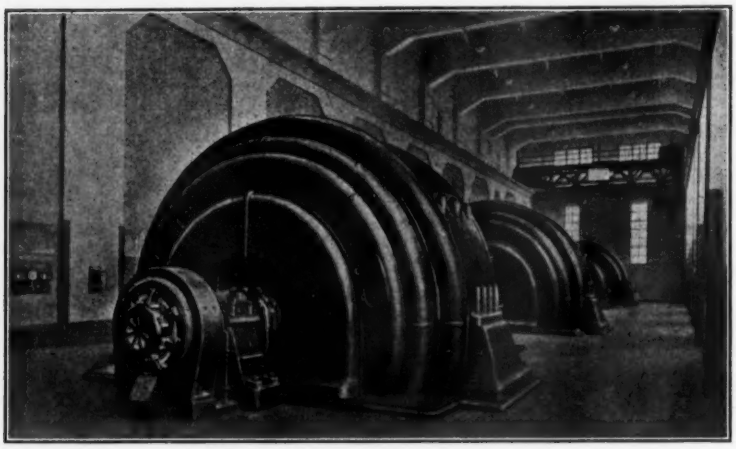
In view of the fact that the plant had to be capable of developing the above continuous and maximum outputs at any pressure between 15,000 and 16,500 volts, and at a speed of 5 per cent. below normal, the windings of the generators, as well as of the exciters, had to be dimensioned accordingly. On the other hand, in order to save as much room as possible in the building in the longitudinal direction, while leaving sufficient space between the units to permit of easy dismantling of the plant, it was necessary to reduce the axial length of the generators as much as possible. For this purpose, the stator bore was increased so as to permit a decrease in the width of the core, and a compact arrangement was adopted for the air-inlet bends. In this way it was possible to make the length of the generators, in spite of their larger capacity, 5 ft. less than in the case of the single-phase generators supplied in 1921 and 1925 to the Amsteg power station.

The accompanying illustration is an internal view of the Vernayaz station, showing two of the single-phase generators and the 14,000-kVA 3-phase generator in the background. The stator of the single-phase machines is divided into four sections to facilitate transport handling. The cast-iron casing, which is of substantial design, rests on two detachable feet and on four rollers arranged under the casing. Once the feet have been removed the whole stator can be turned about its axis

on the rollers and any repairs necessary on its lower half carried out.

The rotor comprises a spider with six arms on which are shrunk five seamless forged rings of special Siemens-Martin steel, machined on all sides. In order to ensure good internal ventilation of the field coils, the rings are separated from each other by an air space of about 1¼ in. Six milled surfaces of the periphery of the rotor rim serve as seats for the pole cores.

The rotating parts of the generator and turbine rest on three bearings, two of which form parts of the alternator. The generator bearing, on the turbine side, has thus to carry, in addition to about half the weight of rotor, the greater part of the weight of the Pelton wheel and the thrust of the water jet. Each bearing is arranged for automatic ring lubrication and the bearing bushes are cooled by means of water circulating in copper coils embedded in the white metal. The generators are totally enclosed, provision having been made in the foundations for fresh and warm air ducts.



Turbine Room of Vernayaz Power Station.

The three-phase alternator used for industrial purposes, 333⅓ r.p.m., 50 periods, 10,000 V, has normal and maximum (60-minute) capacities of 14,000 and 16,000 kVA respectively; with a power factor of 0.75 the efficiency at full load is 95.5 per cent. and 94 per cent. at half load. The design is similar to that of the single-phase generators and is generally in accordance with the Oerlikon large generator practice.

Administration Training.

Suggestions by a F.B.I. Committee.

FOLLOWING upon the publication of the report of the Ministry of Labour upon an inquiry into apprenticeship and training for the skilled industries, which was reviewed in our issue of August 3rd, a special Committee of the Federation of British Industries has issued a report upon education in relation to industrial administration.

In this it is shown how the whole system of industrial control has undergone a complete change during the last fifty years. The most striking results have been the gradual extinction of the personally-controlled company; the merging of operating units into "vertical" or "horizontal" amalgamations, or both; and the growth of Government control in labour and production matters. The smaller enterprises still exist, however, and there is as great a need for adequate educational facilities for the managers of these as for those of the larger undertakings. Management is defined as discovering the best method of carrying out any function concerned with industry; and ensuring that the method is put into practice. When it is considered how many hundreds of varying functions are carried out by the personnel of industry it will be apparent that, although there may be some general principles of administration, the actual practice of administration needs the most expert consideration of some one branch of industry, or even, perhaps, an individual works. The Committee, therefore, concentrates on the common principles of administration and reviews existing facilities. It is noted that the majority of the universities deal with subjects concerned with industrial administration in one or more faculties; some of the newer ones have developed special courses, and have even instituted new degrees. The technical schools and colleges have devoted more attention to the craft side of industry, but in some of them administration courses for foremen and under-managers have been arranged; special mention is made of the work in this direction of the Manchester School of Technology. The institutions, as a rule, confine their attention to particular aspects of the question. Before proceeding to outline the scope of an industrial administration course, the Committee emphasises the fact that personality is an important factor, and therefore only students who appear to have this qualification should be selected; it has to be realised that in the higher ranks of administration posts are very limited in number.

The general scheme proposed is divided under the three main headings of finance, production, and distribution. The first should cover the provision of capital for setting up a manufacturing or distributing enterprise, and also for the financing of the working of such enterprises. In this connection the various forms of business, *i.e.*, private company, private limited company, limited company, amalgamations and associations, including corporations and holding companies, public utility undertakings and voluntary associations, need consideration. This would also cover various types of capital. Working capital would necessitate consideration of banking methods, loans, discounts and credits. Exchanges, speculation and investments, including commodities as well as stock script, are also subject matter which are necessary for an appreciation of movements of currencies as reflected by foreign exchange. Normal accountancy, that is, trading accounts, including balance sheets, would also be dealt with in this section, and taxation, rating, insurance, contributory schemes, bankruptcy, &c.

So far as production is concerned, special attention should be given to the lay-out of works with special attention to routing; stores and store organisation, including stocktaking; power provision and application, especially as a cost factor; machine standards; costing and rate fixing; labour (*a*) selection and training, (*b*) methods of payment, individual agreements, collective bargaining, trade unions and employers' federations, (*c*) welfare and social aspects; Government regulations—the Factory Acts; Public Health Acts and industrial manufacture; nuisances, including smoke and liquid effluents; patents and other forms of monopoly; standardisation and simplification; and research.

The distribution heading should cover advertisement and publicity of all kinds, including the use of exhibitions, the Press, catalogues, posters, trade marks, the kinematograph, broadcasting, business correspondence, &c. Then attention should be given to marketing, and studies should be made of trade channels, wholesale and retail commission merchants, brokers and exporting houses, transport methods and documents, insurance and risks. The personal factor in selling should be examined, and a knowledge should be gained of commodities, languages and general commercial practice in particular countries, trade agreements, &c. The course would also include lectures on trade statistics of production, consumption and marketing movements and their interpretation and use in determining manufacturing policy.

A Railway Signalling Scheme.

With reference to the article under the above heading in our issue of July 27th, we have received the following information concerning the battery and motor-generator equipment at the London Bridge signal box from the D.P. Battery Co., Ltd., which supplied the apparatus. There are two D.P. 64-cell, 11-plate, 500-Ah batteries. The duplicate motor-generators consist of 20-b.h.p. Aston motors, 450-700 V, driving 70-A, 115- to 172-V generators. The switchboard connections are so arranged that either battery can be on charge or discharge alternately, and at the change-over there is no interruption of the feeder circuit. The supply to the motor is taken from the traction rail, and provision is made in the design of the motors to compensate for the heavy fluctuation of the supply voltage.

Swiss Electrical Import Duties.

Under the recent Swiss-German Commercial Treaty certain new rates were arranged by which British trade will benefit under the most favoured nation clause of Great Britain's Treaty with Switzerland. Following are some electrical items with the new rates of duty on import into Switzerland:—

I. Import of parts of automobiles imported separately.—1. (*a*) Electric light machines, not directly connected to other machinery or apparatus: duty chargeable as on dynamo-electric machinery under tariff items 894*a* to 898*a*, according to weight. (The duty under these items ranges from 15 to 35 francs per 100 kg.) (*b*) Electric light machines, connected to electrical apparatus coming under tariff item 956 are dutiable also under the same item, *viz.*, at 40 francs per 100 kg.

2. Electric starters for motor-cars; dutiable under item 956, see above.

An American Outdoor Sub-station.

Some Notes on the New 66-kV Installation at Cahokia of the Union Electric Light and Power Co.

IN order to meet the growing demand for electricity in Southern Illinois, the Union Electric Light & Power Co., of Illinois, America, has recently completed and put in operation a new outdoor 66-kV sub-station at Cahokia, for the following interesting details of which we are indebted to Mr. Stanley Stokes, power supervisor of the Union Co., and the *General Electric Review*. The sub-station has at present an installed capacity of 100,000 kVA. and provision has been made for an ultimate capacity of 150,000 kVA.

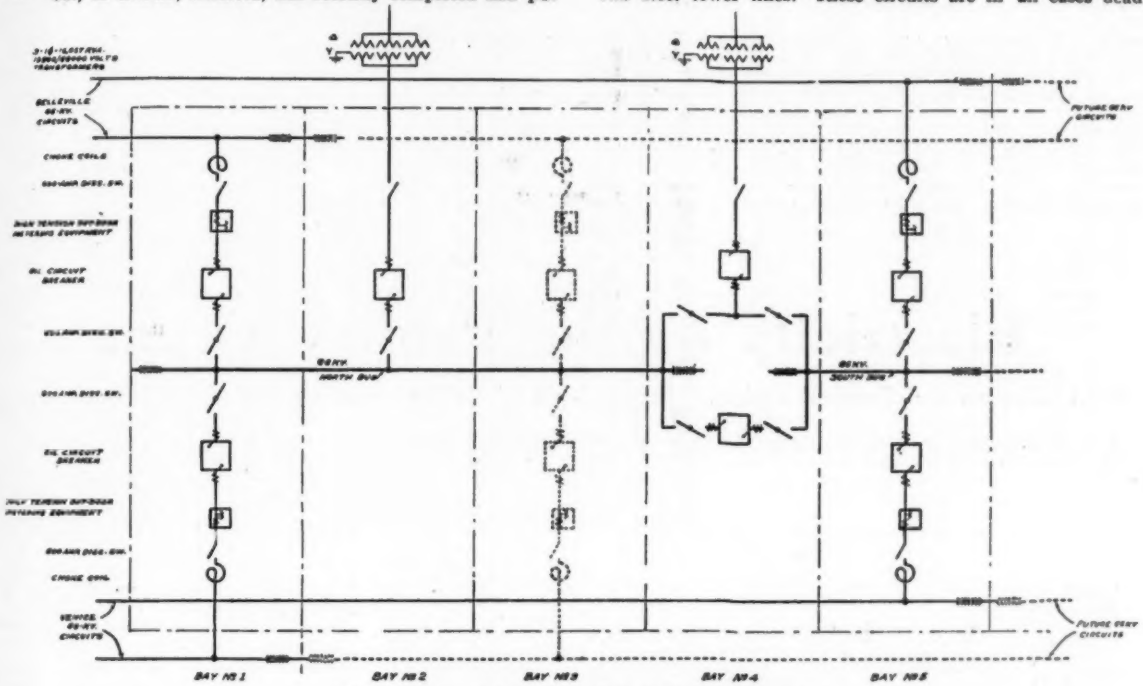


Fig. 1.—General Lay-out of Sub-station Equipment.

At present there are four outgoing 66-kV circuits, two double-circuit lines leaving the structure from the north on two steel tower lines. These circuits are in all cases dead-ended on the structure, and the last tower on each line is an angle tower. One line connects the Cahokia sub-station to a new 66-kV sub-station at Venice, a distance of five miles to the north, and the other line extends to the Illinois Co.'s new sub-station at Belleville, a distance of approximately fourteen miles. An ultimate installation of four

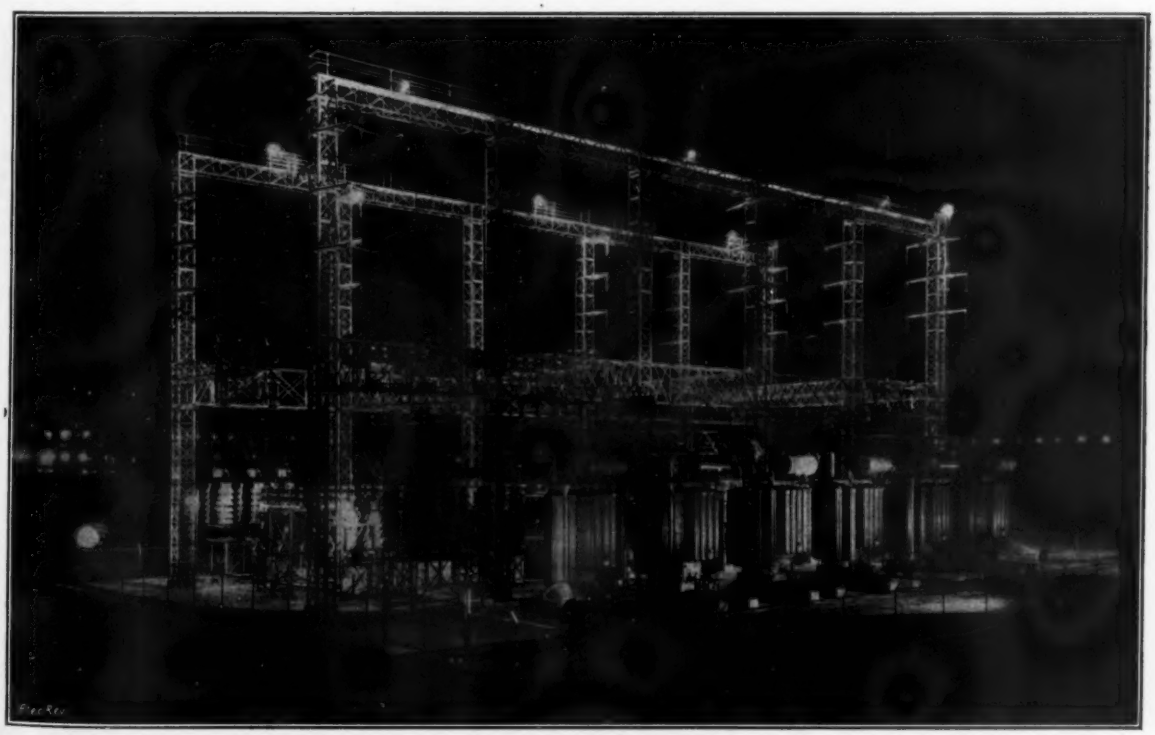


Fig. 2.—Cahokia Outdoor Sub-station at Night.

more circuits can be accommodated on the south side by the addition of two more bays and switching equipment. The steel structure of the sub-station is 75 ft. high, 150 ft. long, and 50 ft. wide. It consists of five bays, each measuring 30 ft. by 50 ft. At present two bays are in use for the feeders and two for transformers, with one reserved for future feeder requirements. The general layout of the sub-station is indicated diagrammatically in fig. 1. When finally completed the station will have four identical bays for outgoing circuits, and two for transformers, accommodation for the bus-bars, as well as for the connections of the reserve set of transformers, being provided in the seventh bay. Six 16,667-kVA, single-phase, self-cooled transformers are at present installed. They are wound for 13,800/69,000 volts, and are delta-connected on the low- and star-connected on the high-pressure sides. The feed of the transformers from the Cahokia power station is supplied through eighteen 1,500,000-circular-mil single-conductor underground cables. These are terminated directly on the low-voltage bus bars and brought up from the conduit run through concrete pillars containing fibre conduit. Of the seven oil circuit breakers installed, six are for the line and transformers, and have 600-A ratings, and the seventh serves as a bus-bar splitter and has a rating of 1,200 A at 73,000 V. The air-break switches are of 600-A rating and are gang-operated, and the lightning arrestors are of 60-kV capacity. All the circuit breakers are equipped with two bush-type current transformers for relay operation. In addition, metering apparatus has been incorporated on all the outgoing feeders.

On account of the fact that the sub-station is of such great importance to the various companies served, in respect of flexibility and continuity of service, it was necessary to provide adequate illumination to allow switching operations to be effected at night. Nineteen flood-lighting units are arranged on the structure in such a way that the beams are concentrated on the switchgear. The spread of the light, however, overlaps sufficiently to produce a uniform intensity of illumination throughout the entire sub-station, eliminating to a notable degree any disagreeable shadows from the larger equipment. Eleven of the flood-lighting units are equipped with 500-watt lamps and eight with 200-watt lamps. The larger ones are placed along the top of the structure and fence and the smaller units at other advantageous points. Fig. 2 is a night view of the sub-station.

Electricity on the Poultry Farm.

Some notes on the electrical equipment at the farm of the Buttercup Dairy Co., at Corstorphine.

As the long arm of electrical development stretches further and further afield, so does it secure contact with many industries in which only a few years ago it was almost an unknown factor.

Fig. 1.—External View of Laying-Stock Huts.

An excellent example is the poultry breeding and rearing industry, in which electricity has been proved advantageous and is particularly adapted to supply the warmth and comfort which in this specialised industry are so vital. Mortality amongst day-old chicks and laying hens is perhaps due to dampness more than to any other cause, and it is the chief cause of financial loss. With electricity on the poultry farm this contributory of disease and death amongst stock can be combated to a great extent, and financial gain is almost certain to be the result. Egg-production is increased the preparation of birds for the table is speeded up, young birds are more easily reared, the keeping clean of stock and buildings becomes easier, and the feeding of the birds is much simplified.

At the Corstorphine poultry farm of the Buttercup Dairy Co., Edinburgh, at which over 100,000 chicks can be hatched and reared annually, the breeding and rearing of poultry is carried out intensively by means of electricity, and on the most up-to-date methods. The supply system is 230-volt, 50 cycles, 3-phase, and all the incubators and brooders are automatically controlled. As warmth is so vitally necessary for the proper rearing of stock, a special system of electric hot-water heaters is in operation, and the 100 huts for the laying stock, fig. 1, are each equipped with three immersion heaters, 85 to 90 watts, for the drinking troughs, to prevent the water freezing during the winter. The heating installation was carried out with 3/.029 Class "A" and 11/.012 S.R.2 cables supplied by Messrs. W. T. Henley's Telegraph Works Co., Ltd., and the lighting installation was carried out with "Maconite." The two brooders, fig. 3, are equipped with 150-watt "Morganite" heaters—a total of 496 being in use—and 248 Philips "Night Save" lights. The whole of the cables in the brooders, for lighting and heating, are also of Henley manufacture. The incubator house, fig. 2, is provided with a special system of electrical heaters comprising thirty 500-watt wire elements. The total number of huts devoted to the rearing of young stock is 110, each of which is equipped with a 300- to 350-watt "Morganite" heater. The whole of the internal wiring is carried out with Henley materials—for lighting and power—and Maconite" is used for leading-in purposes. The installation also includes electrical machines for blending the various foodstuffs for poultry feeding and electrical machines to facilitate the plucking and preparing of birds for the market. The lighting arrangements, which form an important feature of the installation, provide a total load of between 500 and 600 W. Over 200 breeding pens which

Fig. 2.—The Incubator House.

will shortly be installed will be electrically lighted and equipped with immersion heaters. Henley tough-rubber-sheathed flexible cable will be used in this connection. The whole of the wiring work was undertaken by the electrical staff of the Buttercup Dairy Company, under the supervision of Mr. F. Gibson, electrical engineer to the company. We are indebted to Messrs. Henley's for the accompanying illustrations.

Fig. 3.—Interior of one of the Brooders.

A New Protective System.

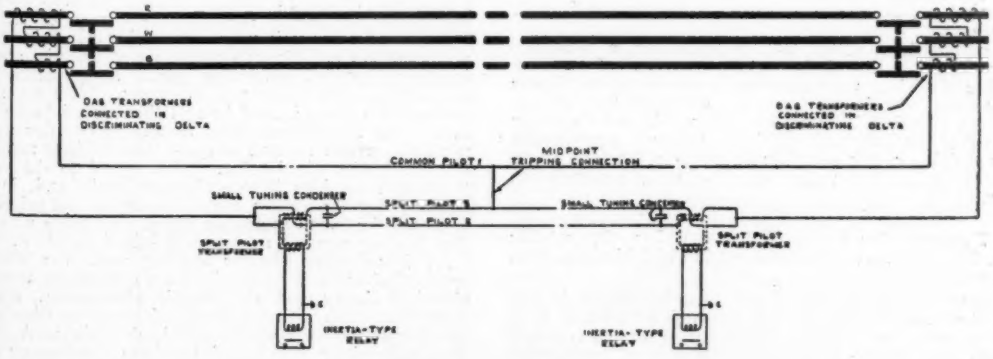
Some particulars of the Split-Pilot Feeder Protective Equipment introduced by Messrs. A. Reyrolle & Co., Ltd.

WHEN an extensive electrical transmission system is divided up into sections or units from the switching point of view, the protective gear applied to it must have two essential characteristics in relation to any section: first, it must have inherent stability under normal conditions or for straight-through currents, so that unwanted tripping is avoided; and, secondly, it must possess infallibility of operation, and must immediately cut out any section within which a fault may have occurred.

The Reyrolle split-pilot feeder-protective gear, it is claimed, has these two characteristics in a marked degree because of its mid-point tripping connection. The accompanying diagram shows the arrangement for a plain link between two points of a system, with only one set of protective transformers at each end, but it can be extended to give overlap protection where a branch is included at either end of the section, in which case a second set of transformers is connected in series with the first at that end. The principle of the arrangement will be easily followed from the diagram. At each end of the pilot system a set of three D.A.G. current transformers is connected in series in a novel way, called "discriminating delta," by means of which lower settings are obtained for earth faults than for phase faults, and particularly sensitive operation is achieved. The two sets of transformers assist each other normally, and are connected together by one pilot wire on one side, and on the other by two wires, which, together, make up the second pilot; hence the system's name "split-pilot." Relays are connected in the split-pilot in such a way that when equal currents flow, as they normally do, in the two halves of their windings, their effects neutralise each other, and there is no tendency to trip. If there were no mid-point tripping connection, the current in the pilot circuit, whatever its magnitude, would always divide equally between the two relay windings, and the arrangement would be inherently so stable that it would never trip at all on the occurrence of any fault, either within or outside the protected section.

Some addition has therefore to be made to provide means for tripping as soon as a fault current flows, and this takes the remarkably simple form of the mid-point tripping connection, which, as the diagram shows, is merely a plain cross-connection between the mid-points of the common pilot and one of the cores of the split pilot. These are equipotential points under normal conditions, and the addition of the tripping connection does not disturb the system in any way as long as there is no fault. If a fault occurs, however, one set of transformers will produce and carry a greater current than the other set, and the increment is equivalent to a tripping current superposed on a still inherently balanced circuit. If, for example, the left-hand set of transformers is carrying the additional current, this will circulate along the left-hand half of the common pilot, and across the tripping connection, and will then return towards the transformers by two parallel paths leading to the left-hand junction of the split-pilot cores, one of which paths is obviously three times as long as the other. This means that three parts of the tripping current take the short path, while one part takes the long path, and it can easily be shown, taking into account the relative effects of the relay windings, that the result of adding the mid-point tripping connection is to make equal amounts of energy available for tripping at each end of the system.

Among the advantages claimed for the Reyrolle split-pilot protective gear are its simplicity, its self-balancing property, the robustness of its working parts, the irresponsiveness of its relays to currents of abnormal frequency, its independence of the value or the vector direction of the voltage, either of the main or of the pilot circuits, the possibility of enclosing all the conductors and terminals of the pilot circuit within earthed metal, and the promotion of the safety of operators by reason of the fact that the tripping relay, which is the only part of the apparatus that ever needs to be adjusted or handled, is entirely isolated from the pilot cable because of its connection with the secondary winding of the split-pilot transformer, and can, in addition, be earthed by the earthing of one terminal of the secondary circuit of the transformer.



Arrangement of Simple Split-Pilot Protection.

Reviews.

Steam Condensing Plant. By JOHN EVANS, M.Eng. Pp. xii+202; figs. 74. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

The authors of technical books, as well as the writers of papers for our technical and scientific institutions and societies, have, generally speaking, dealt adequately with the design and construction of both the boilers and the turbines which constitute the basis of the steam side of the equipment of a modern electric power station. It is, however, undoubtedly the fact that as regards the steam-condensing plant, this part of the equipment is far from having received the attention it merits. There is no purpose which can be usefully served by inestvigating the relative importance of the three essential parts of the steam side of the machinery of power stations, *viz.*, boilers, turbines and condensers, but certainly as regards its effect upon the efficient operation of the station as a whole the condensing plant is not the least important. Again, the consequences which may follow any irregularity in the working of the condenser and its auxiliaries, such as an excess of air entering the boilers, may be very serious indeed, and it is one of the most vital of the many duties of the power-station engineer to see that the condensing plant is functioning as it should. But the developments in modern steam-condensing practice tend to make the condensing plant more and more extensive and complex, and it is only by a thorough comprehension of the theories underlying its operation that the engineer can hope to obtain the best results from it.

In brief, the book deals with the principles underlying the design and operation of modern steam-condensing plant, and is written for the practical man who is engaged in installing or in operating and maintaining steam power plant such as is found in the electric power station. After a short introductory chapter in which the author deals with the functions of the condenser and its essential auxiliaries, and with the importance of producing a high vacuum in conjunction with a steam turbine, he devotes two chapters to the surface condenser, outlining the considerations affecting the design of the condenser, and then describing with adequate illustrations all the well-known makes of condenser used in modern power-station practice. Chapters are then devoted, respectively, to jet condensers, evaporative condensers, and to ejector condensers. Then we have two chapters on air pumps, the first dealing with the various forms of reciprocating and hydraulic pumps, while the second deals entirely with the various forms of steam-jet air pumps or vacuum augmenters, as they are more usually termed. A chapter is then devoted to the subject of feed water systems, including the various closed feed systems, and dealing with such essential operations as de-aeration and feed heating, the latter including heating by bleeding from the main turbine. Finally, there is a chapter on cooling towers and spray ponds. It will be realised, therefore, that the author has covered his subject well, and has not been content to deal merely with the condenser itself, but also with the various auxiliaries which, with the condenser, constitute the condensing plant. We should have liked to see certain other things included, such as the circulating pumps, economisers, &c., but this might have extended the size of the book beyond the limits of what the publishers considered advisable. With these qualifications we have nothing but praise for this little book. The treatment of the subject throughout is clear, and no excessive knowledge of mathematics is required either to understand the more theoretical parts of the work or to follow the numerical examples which are liberally interspersed throughout the text. It is essentially a book for the practical engineer, and to such we recommend it with confidence.

The information which is required for a complete understanding of the design and operation of modern condensing plant has, we venture to assert, been conspicuous by its absence, both in our text-books and from the proceedings of our technical institutions. We would not go so far as to say that the little book which lies before us compensates for that deficiency, but certainly it meets a long-felt want, and should find a place in the library of every power-station engineer.

Steam Turbines. By EDWIN F. CHURCH, Jnr. Pp. x+273; figs. 225. London: The McGraw-Hill Publishing Co., Ltd. Price 15s. net.

The steam turbine is one of the most important, if not, indeed, the most important, type of engine which is used at the present time for driving electrical generators, and its design has become a specialised branch of engineering science. Nevertheless, although there are only a few firms in this country which are prepared to design and construct a steam turbine to fulfil a given set of conditions and, consequently, although there are only a few men, representing the designing staff of these firms, who may be called upon to undertake the design of a turbine, the problems connected with the design of turbines form a part of the syllabus of the majority of the examinations for the degrees in engineering science and for the associate membership of our premier technical and scientific institutions. It follows, therefore, that every engineering student must acquire a certain amount of knowledge of the problems met with in the design of steam turbines and of the principles which underly such problems. The text-book under review, which is of American origin, has been written with the idea of meeting the requirements of such students, but it differs from the large number of similar books which we have examined in that it attempts to deal with only such parts of the subject as are absolutely essential. The author confesses that he has found the majority of the text-books, excellent as he admits them to be, too large for his purpose, and he has prepared a volume to meet the requirements of his own students, but which, we think, will be found acceptable to many other students studying for examinations similar to those which the author himself has in mind. With a view to keeping the book within reasonable limits, he has omitted entirely all reference to the subject of thermodynamics, it being assumed that the student, when he commences to study the design of turbines will possess a thorough knowledge of all the principles of thermodynamics required. For a different reason no steam tables or charts have been included, as the author is of the opinion that the completion of the work of the American Society of Mechanical Engineers Committee on Steam Research and Extensions of the Steam Tables will introduce many changes in the values which are at present in use. Thus, the author begins his treatment of the subject on the assumption that the reader is possessed of sufficient scientific and mathematical knowledge to enable him to follow at once the specific problems of turbine design, a treatment which will at once appeal not only to many students, but to the many experienced engineers who are anxious to obtain a specialised knowledge of this subject. After a brief survey of the various types of turbines and their characteristics, the classification being based not only upon the way in which the energy of the steam is utilised, *i.e.*, upon the utilisation of the "impulse" or the "reaction" principle, but also upon such factors as the arrangement of the casings and the purpose to which the turbine is to be put, the author devotes a chapter to steam nozzles, another to blading, one to a study of the various losses in a turbine and the methods whereby they may be estimated, one to a discussion of the problems of efficiency, reheat factor and condition line, and, finally, one to the methods of obtaining output variation and the problems of governing. Having thus considered the fundamentals of his design, the author finally applies them to a complete machine, and for this purpose he considers a turbine of 5,000 kW at a speed of 2,400 r.p.m., working out the details for both an impulse turbine and a reaction turbine. The mechanical side of the question, such as the design of the shaft, of the disks or of the rotor, it will be observed, is not dealt with, this phase of the problem coming more under the science of mechanical engineering. In order to indicate that the investigations would be applicable to machines of any size, a number of problems are appended at the end of the book, these being classified according to the chapters under which their solution falls. It is to be regretted that the answers to these problems are not given.

This book forms a welcome addition to the literature of the steam turbine, and it is one which should prove of the utmost value, not only to the student, but also to the engineer and the draughtsman who has to deal in any way with the design of any form of steam turbine.

Naval Electrical Manual, 1928. Vol. I. By C. L. FORTESCUE, O.B.E., M.A., M.Inst.C.E., M.I.M.E. Pp. xii+812. London: H.M. Stationery Office. Price 12s. 6d. net.

This book, which supersedes the "Torpedo Manual," Vol. I, 1911, has been written by Prof. Fortescue, for the purpose of providing a standard treatise on the theory of electricity, for the use of the officers and men of H.M. Fleet. The ground covered is wide, comprising not only the theory of magnetism and electricity, and its commercial applications in generating and converting plant and motors, but also illumination, telegraphy and telephony. With regard to the scope of the book, it may be said that, as might be expected in a Naval Manual, electrical machinery has devoted to it a relatively greater amount of space than subjects more directly concerned with distribution. With regard to the manner of treatment, the bias is somewhat academic, and, in spite of the fact that the author has started from first principles, the work will be found somewhat difficult for those whose education has not reached a secondary school standard.

An introductory chapter dealing with the fundamental mechanical units is followed by an elementary treatment of electrical theory and electrostatic phenomena, the subject being illustrated with a fuller development of Ohm's law and its applications to simple electrical calculations. A chapter on electro-chemistry is followed by three chapters on magnetic theory, after which direct-current measurements, instruments, and meters are dealt with. The superficial manner in which matters appertaining to distribution are treated is here illustrated in the section dealing with fault localisation. No mention is made of either the fall of potential or the induction methods, whilst the method of locating a short circuit illustrated on p. 210 depends on two earth connections whose resistances are negligible, compared with that of the cable, and is one which would have to be used with extreme caution when a fault on a power cable had to be located. The subject

of direct-current machinery is dealt with thoroughly, and in considerable detail, and this portion of the book contains a good and practical account of motor control gear, and the operation of direct-current machinery. The subject of illumination is treated very ably in a lengthy chapter, which deals not only with the theory of this subject, but also with photometric measurements and calculations. Considerable space is devoted to elementary alternating-current theory and the calculation of alternating-current circuits. The chapter on alternating-current instruments is not so satisfactory. There is no reference to instruments of the induction type, whilst the only synchroscopes described are both of obsolete pattern. The lack of reference to the a.c. watt-hour meter is remarkable. The treatment of alternators and static transformers is copious and satisfactory, as is the chapter on the polyphase induction motor. The reference to phase advancers is too scanty, and there is little justification for dismissing the single-phase induction motor, in a work of this character, in one short paragraph comprising half a page. A brief note on frequency changers, at the end of the chapter dealing with synchronous motors, refers to the synchronous-induction type of motor-generator as if it were the standard type of machine for interconnecting systems of different frequencies. As this is the only reference in the book to frequency changers, the note as it stands is misleading in the extreme. Converting plant is very ably treated, and ample space is accorded to the mercury-arc rectifier. The chapter dealing with transmission and distribution is generally scanty and unsatisfactory. An inordinate amount of space is taken up with an analytical investigation of Kelvin's law, but the subject of cables and automatic protection is dealt with very superficially. The Merz-Price system is shown using a single pilot with an earth return, whilst the split-conductor system is illustrated with an oil circuit breaker having single contacts. The final chapter deals with the fundamentals of telephony and telegraphy.

The book contains a number of questions for solution, the answers to which are given in the appendix. There is a good index. The illustrations are not of a high order, and the standard conventions for diagrams of connections are largely ignored. Those desirous of obtaining a comprehensive treatise on the theory of electricity and electrical machinery, will find in the present work a copious and generally authoritative book at a very reasonable price.

Kempe's Engineers' Year Book, 1928. 35th Edition. Edited By H. R. KEMPE and W. HANNEFORD SMITH. Pp. 3169+81; illustrated. London: Crosby Lockwood and Son. Price 30s. net.

Once again the new edition of this book has involved an increase in the number of pages, the addition this time being 70. It is felt that with this continued growth the full value of the mass of information contained in the three thousand odd pages may be lost in the resulting confusion. In the preface to the 1928 edition appears: "It will be obvious, therefore, that the nature and extent of the alterations made cannot be measured in terms of the numerical pagination total, . . . "; in the absence, inevitable perhaps, of any sort of co-ordination between the various sections and sub-sections, and so on, the value of the work would be enhanced indeed by an actual reduction in the number of pages. Judging purely from the electrical contents, some sort of co-ordination between the sections is certainly needed—there seems to be more electrical engineering material outside the chapter on electrical engineering than within it. A useful addition to this section is the Regulations of the Electricity Commissioners. The usual abbreviated I.E.E. Rules are given, covering the 9th (1927) edition. It is disappointing to see the section on "Domestic uses of electricity," word for word, the same as in the previous edition and dismissed in under two pages—so much has happened of late in this connection—while one particular firm's well-known wiring system—also reprinted word for word—is given about four pages. As usual, the progress made in the electricity supply industry during the year prior to publication is outlined in the opening chapter—"The past year's progress."

Thermodynamics Applied to Engineering. By ARTHUR F. MACCONOCHIE. Pp xiv+260; figs. 65. London: Longmans, Green & Co., Ltd. Price 12s. 6d. net.

Of the many books on the subject of applied thermodynamics which have been published during the last year or two, this may be said to strike a distinctly novel note. This may, perhaps, be due to the fact that it emanates from the United States of America, the author being the Associate Professor of Mechanical Engineering in the University of Virginia, although we must hasten to add that he is also a Bachelor of Science in Engineering of the London University, which would suggest that part, at least, of his training has been obtained in this country. In any case, while the principles of thermodynamics are the same in every country of the world, their applications to engineering practice yield strikingly different results, as is evidenced from the difference between engineering practice in this country, and, say, France. The author has, therefore, endeavoured to surmount this obvious difficulty by illustrating the application of the principles of thermodynamics by reference to the best modern British and American practice.

The book, which is not divided into chapters, as is usual in British scientific and technical text-books, comprises three separate sections, the first dealing with the usual theoretical principles of thermodynamics, while the second and third cover the applications of those principles to the external combustion engine and the internal combustion engine, respectively. At the conclusion of each section there are appended a number of "Topics for Discussion," followed by a few worked examples and a number of examples for practice. The topics for discussion, it may be mentioned, are similar to the familiar descriptive questions of our own examination papers, while of the worked examples, as well as the examples for practice, a number are taken from the B.Sc. (Engineering) examination paper. The worked examples form a very valuable feature of the book, the solutions being very clearly and systematically set out, but we are sorry the author has not given the answers to the examples for practice, as nothing is more essential to the progress of the student than the knowledge that he has worked his numerical examples correctly.

We need not refer in detail to the contents of Section I, as this part of the volume is based upon conventional lines, although we are pleased to note that a few paragraphs on fluids in motion, referring particularly to steam, have been included in this section. In the two subsequent sections the author has endeavoured to include the most recent developments in heat-engine practice, and thus we find in the section dealing with the external combustion engine that after an analysis of the thermodynamics of the boiler, the author deals with the binary vapour engine, using mercury and steam, describing the cycles of operation, both as regards the boilers and the turbines, while he expresses the opinion that engines employing this principle are likely soon to be developed upon a manufacturing basis. The reciprocating steam engine, as well as the steam turbine, are next examined, and, by way of an example of each, a description is given of a uniflow engine and an impulse-reaction type turbine. In the section on the internal combustion engine we find the conventional treatment of the Otto and Diesel cycles, although the author lapses from grace in describing the sliding-cylinder, double-acting, two-stroke-cycle Diesel engine, as this type may now be considered obsolete in view of the development of simpler double-acting types. This is followed by a very interesting treatment of the gas turbine, based upon the historic paper presented by Professor Marks before the American Society of Mechanical Engineers, which will be familiar to many of our readers, while there is also an investigation of the theory of the exhaust-gas turbine, which is gradually becoming recognised as a valuable adjunct to the large internal combustion reciprocating engine. A brief survey of the principles of refrigeration completes this section. At the end of the book are to be found, in addition to a comprehensive index, a number of useful tables of the properties of steam, mercury vapour and ammonia, as well as tables of trigonometrical functions and logarithms. There are also two folding charts of the Mollier diagram for steam and ammonia, the latter for use in conjunction with problems on ammonia refrigerating machines.

The book, as a whole, has been very carefully written, without any excessive length in the descriptive matter, and the printing of the text, as well as of the diagrams, is commendably clear. At the relatively low price of 12s. 6d. it is a remarkably good production. Although it must make its strongest appeal to the engineering student, the book can be recommended to the busy engineer who is desirous of understanding the theories underlying the more recent developments in heat-engine practice.

Drafting for Engineers. By C. L. SVENSEN, M.E. Pp. xii+363+vii; 584 figs. London: Blackie & Son, Ltd. Price 12s. net.

This textbook of engineering drawing is the work of a professor of that rubject at the Texas Technological College, and naturally follows American practice; but the language of the draughtsman in the main is universal, subject to local conventions, which are easily understood, and the author's treatment of the subject is so efficient and thorough that his teaching should be of great value to readers of whatever nationality.

Beginning with chapters on instruments and their uses, engineering lettering, and engineering geometry, the author proceeds to discuss the various methods of projection very fully, after which he devotes a whole chapter to bolts and screws (American standards). Chapters follow on working drawings, sketching, pictorial and architectural drawing, and a variety of special subjects, including one on electrical engineering drawings, which is necessarily somewhat superficial. The last chapter consists of problems occupying 70 pages, for use in teaching An appendix gives particulars of the standard (first-angle) method of projection used in this country, together with tables of British standard screw-threads, nuts, and pipe flanges.

The book, as a whole, can be recommended as well worth its comparatively moderate price, and adequately covering the subject in a very practical way.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A New Electric Tractor.

The accompanying illustration, fig. 1, shows a new electric tractor which has been recently introduced by Messrs. Dodds and Clark, Somnerfield Works, Haddington, and which attracted much attention at the recent "Highland" Show at Aberdeen. The machine is the invention of Mr. A. T. Clark, sole partner of the firm, and Mr. F. W. H. Shepherd, works

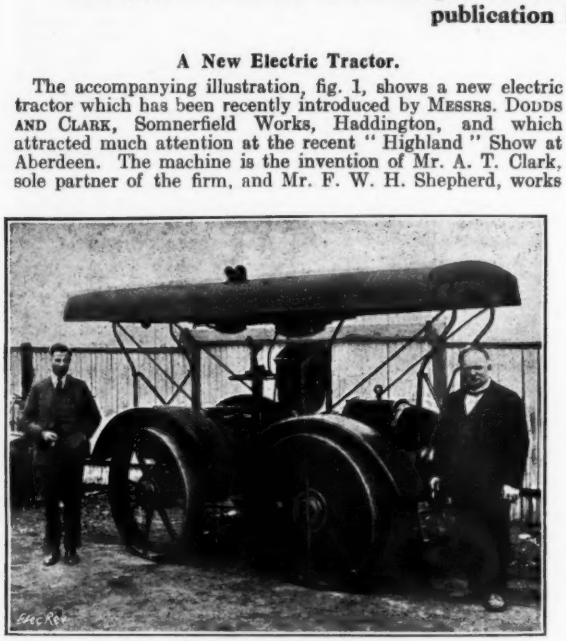


Fig. 1.—An Electric Tractor.

manager. The main feature of the machine, which is designed primarily for agricultural purposes, is the steering, which is arranged for easy manipulation of the tractor at the headlands, without turning, the ploughs or other implements, being fitted at both the back and front of the tractor. The steering gear has a triple action controlled by the change lever on top of the steering wheel. When the tractor is traversing a field, steering is effected by the front or back pair of wheels, according to the direction of movement, the other pair of wheels being locked to the frame. At the headland all four wheels steer in echelon to permit moving sufficiently on new ground. All four wheels drive. A special coiling device is fitted in the canopy for taking up and paying out the electric cable during the tractor's travel across the field.

Ornamental Table-Lamp Standards.

Electric table standards in wood and metal efficiently serve their purpose, but there is a demand for something more elegant and of more pleasing appearance which can be achieved by using as raw material a highly artistic composition. After searching for a raw material suitable for the purpose. Messrs. Goodworks, Ltd., Retreat Place, Homerton, E.9. have succeeded in creating electric standards quite uncommon and

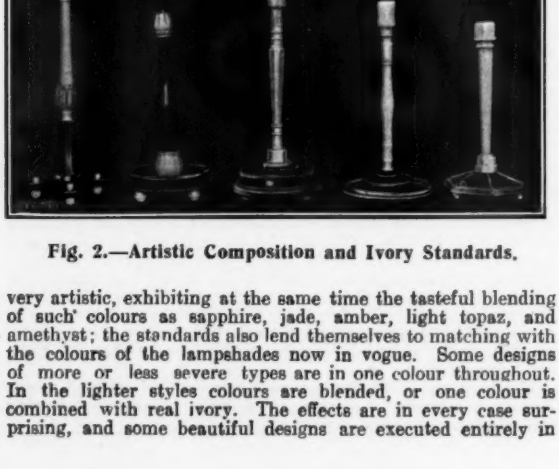


Fig. 2.—Artistic Composition and Ivory Standards.

very artistic, exhibiting at the same time the tasteful blending of such colours as sapphire, jade, amber, light topaz, and amethyst; the standards also lend themselves to matching with the colours of the lampshades now in vogue. Some designs of more or less severe types are in one colour throughout. In the lighter styles colours are blended, or one colour is combined with real ivory. The effects are in every case surprising, and some beautiful designs are executed entirely in ivory. The firm has the great advantage of having as chairman a gentleman who is considered to be one of the world's finest ivory experts. Combining a highly-trained staff of workmen with a well-equipped and modern factory, in spite of having introduced this special line only a few months ago, the concern is fully occupied to-day. The workmanship throughout is of high British standard, and the fact that in the past the production of such articles has been largely in the hands of the foreigner makes the subject more interesting. Fig. 2 shows a selection of the standards.

A New Magneto.

Messrs. A. Rist (1927), Ltd., Waveney Works, Lowestoft, have recently introduced in this country the "Voltex" magneto, fig. 3, which, it is claimed, will spark at lower speeds than other magnetos of similar size and weight, *e.g.*, from 40 to 50 r.p.m. Further, its design is such that it can be easily allied with battery ignition. The rotary principle is employed, and highly efficient stationary windings are used, thoroughly insulated by a bakelite casing. The rotor is a die casting with the laminations and the shaft inserted. The slightly inclined distributor shaft is driven by helical gears, thus enabling the distributor and contact breaker to be easily inspected

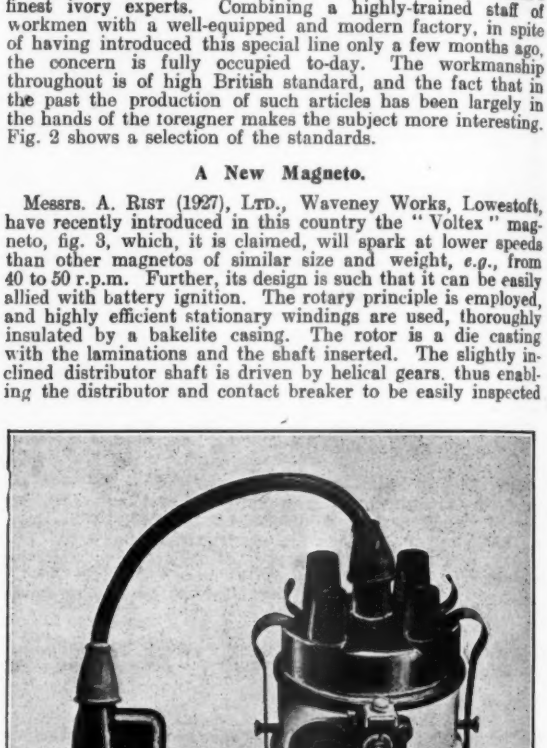


Fig. 3.—The "Voltex" Magneto.

and the contacts adjusted. For dual ignition an auxiliary coil is used, and the current is passed through the magneto winding and actually assists in keeping the magneto permanently magnetised.

An Automobile-Lamp Cabinet.

The Edison Swan Electric Co., Ltd., 123-5, Queen Victoria Street, E.C.4, has recently introduced a cabinet for the use of the "trade" for stocking all types of "Ediswan" motor-car lamps. The cabinet measures 18 in. by 11½ in., and is designed to hold 72 lamps. It is decorated in gold, carries the Royal Warrant and the words "Royal 'Ediswan' Motor Car Lamps," and constitutes a useful and ornamental piece of shop furniture.

American Automobile Electrical Equipment Exports.

The monthly American export returns now include a separate heading relative to the exports from the United States of sparking plugs and ignition, lighting and engine-starting equipment for motor vehicles. The latest figures available are those for the five months ending with May last, during which period the shipments of sparking plugs attained a value of £75,690, and of the other equipment mentioned, £102,159, the combined total of £177,849 comparing with £174,366 in the corresponding period of 1927.

Electro-Plating.

The possibilities of Standardising the Solution for Nickel Plating.

AT the general meeting of the Electroplaters' and Depositors' Technical Society held in June, a discussion took place on the possibility of standardising the nickel-plating process.

The president, Mr. S. Field, in opening the discussion, said that in nickel plating there were a great number of suggested formulæ which should be reduced to a minimum number of standard solutions. Persistence of present conditions could only lead to confusion. Chlorides such as those of potassium, sodium and nickel were added to effect anode corrosion; sulphates such as those of ammonium, sodium and magnesium, were added to improve the conductivity; and boric acid functioned as a buffer, and so on. It should be possible to select from amongst those substances a number which could be put forward as standard solutions.

Mr. E. A. OLLARD outlined the work which the recently appointed Standards Committee proposed to do. The Committee had already started work and considered several problems. It was felt that the first thing to do was to standardise the various chemicals used, and then the composition of suitable solutions. The standardisation of chemicals was a difficult task which required time, and the committee required the hearty co-operation of all members in the task, who were asked to give freely of their experiences.

Mr. L. P. SIDNEY thought that the colour test would only be reliable in comparing solutions of a similar nature.

Mr. A. W. HOTHERSALL contended that the Standards Committee should be careful to approach the matter from the correct angle. It was important to define the purpose and requirements which it was trying to satisfy. In regard to the hardness of a deposit, while the plater preferred to have a deposit which was easy to polish and which he called "soft," this same deposit might be called hard in the engineering sense; for it was probable that a hard nickel deposit with a small grain size was generally easier to polish than a softer deposit having a coarse grain size, and therefore a rougher surface. He thought the committee ought first to determine the requirements of the different branches in the industry.

Mr. S. WEILL asked: when a standard grade of nickel was specified for anodes, could they persuade the manufacturer to manufacture it? Again, the plater who was going to use standard solutions would have to compete against the plater who still used slip-shod methods and turned out inferior work cheaper. Further, there were many platers who would not like to change over to standard solutions because they were probably proud of their present methods. Further progress lay in the direction of hot nickel solutions, and for rust prevention the best way was to underlay with cadmium.

Mr. L. WRIGHT supported nickel plate as a protective. If it were thick enough—say, 0.003 inch—it gave very good protection, even after three years' service. Speaking on the subject of chlorides in nickel solutions, there was a large range of chlorides which could be used, *e.g.*, those of sodium, potassium, ammonium and nickel. The chloride ion assisted anode corrosion, and it would be interesting to have the views of practical men on the merits of the various chlorides. The kind of deposit obtained did not depend solely on the composition of the solution, but also on the conditions of deposition. Thus, by arranging these variables suitably, it was possible to get deposits of equal Brinell numbers from both single and double salt solutions.

Mr. E. J. DOBBS said it was remarkable that solutions existed which theoretically should give no deposit at all, yet could be worked in practice. There were other factors which were important beside the purity of the salts, *e.g.*, the weather was supposed to affect the solution, and the Standards Committee would be well advised to explore these other factors.

Mr. J. W. PERRING said it was impossible to lay down a solution which would be suitable for every purpose. "Building up" deposition required at least two types of solution, one to give the hard deposit demanded by some customers, and the other for soft deposits which could be easily machined. It would be necessary to group the solutions required for different purposes into a number of types and try to standardise each type. The procedure of the Committee should be to get into touch with the manufacturers of the material being standardised in order to find out first what purity was available.

Mr. W. T. GRIFFITHS said his company tried to produce the purest possible nickel. It it were proved that a small amount of a certain impurity were detrimental to the plater, they would be prepared to try to exclude it, although it might mean putting up the percentage of another impurity, which would not be detrimental. He suggested that the Standards Committee should consider the viewpoint of the manufacturer, since it might prove impossible otherwise to put a given specification into practice.

Electricity in Mines.

Annual Reports of the Secretary for Mines and H.M. Inspector of Mines.

THE annual report of the Secretary for Mines and that of H.M. Chief Inspector of Mines (H.M. Stationery Office, price 5s. 6d. net) for the year ended December 31st, 1927, were issued recently. The Secretary announces that although the picture for 1927 is gloomy, the fact remains that, as compared with 1925, the output was increased by about 8 million tons, and the export trade, including foreign bunkers and the coal equivalent of coke and manufactured fuel, by about half a million tons. The adverse conditions of 1927 are reflected in the large number of pits closed during the year. Of those restarted since the settlement of the dispute in 1926, 502 pits, chiefly situated in the exporting districts and employing 55,600 workers, were closed again. A number of new pits were opened, but most of these are small and employ comparatively few workers. The total output of coal in Great Britain for the year was 251¼ million tons, and the shipments abroad amounted to 72 million tons. During the period under review just over 20 per cent. of the saleable coal raised was treated in the 546 coal-washing and -cleaning plants then in use. Sixteen new types of electric lamps were received during the year; of these eleven were approved, three were certified for trial underground, and two failed. The lamps passed included one with a 6-V battery. In addition, two modifications of types already approved were submitted, of which one was approved. Tests were continued from the previous year of three lamps fitted with firedamp-detecting devices; one of these was passed and formally approved early in 1928, and another was certified for trial underground. In relation mainly to the preparation of a British standard specification for 2-V miners' lamp bulbs, efficiency and life tests and other experimental work were carried out.

The Chief Inspector's report shows that during the year 212,525 persons were employed at the surface, and 824,866 persons underground, at mines under the Coal Mines Act, 1911. The number of persons killed was 1,128, and the number injured 173,449. The death rate per 100,000 manshifts worked in 1927 was 0.45, as compared with 0.40 for 1925. Nine deaths during the year were due to electric shock. Of the eight which occurred underground four were the result of damage to trailing cables due to carelessness. The coal supplied during the year to electricity generating stations belonging to authorised undertakings and to railway and tramway authorities amounted to 8.96 million tons, as compared with 8.08 million tons for 1925. The amount supplied to gas undertakings was 16.97 million tons.

The following table indicates generally the use made of electrical equipment in the coal mines. While the total number of mines at work in 1927 increased to 2,861 from 2,721 in 1925, the number of mines at which electrical equipment was installed was reduced from 1,589 in 1925 to 1,528; but the actual number of motors in use increased from 33 041 in 1925 to 36.095 in 1927, and the aggregate horse-power of the motors installed rose from 1,556,235 to 1,684,123.

Electrical Plant and Equipment.

	England and Wales.	Scotland.	Great Britain.
Total mines at work	2,355	506	2,861
Mines at which electrical equipment is installed ...	1,209	319	1,528
Number of electric motors in use	27,242	8,853	36,095
H.p. of motors in use—			
Below ground:			
Haulage	303,191	62,428	365,619
Conveyors and loaders ...	6,437	7,848	14,285
Pumping	274,227	97,343	371,570
Portable machinery:—			
Coal-cutting machines	55,989	42,387	98,376
Other machinery ...	1,313	1,468	2,781
Miscellaneous	18,612	7,068	25,680
Total	659,769	218,542	878,311
Above ground:			
Winding	136,797	11,348	148,145
Ventilation	103,623	9,252	112,875
Haulage	65,485	7,998	73,483
Coal washing or screening	123,213	18,450	141,663
Miscellaneous	309,943	19,703	329,646
Total	739,061	66,751	805,812
Grand total	1,398,830	285,293	1,684,123
Number of mines at which coal-cutting machines were in use	659	270	929
Disk type	354	509	863
Bar	354	386	740
Chain	2,531	678	3,209
Percussive and other machines	2,258	46	2,304

	England and Wales.	Scotland.	Great Britain.
Total number driven by—			
Electricity	1,939	1,539	3,478
Compressed air	3,558	80	3,638
Total number of machines	5,497	1,619	7,116
Total quantity of coal cut (tons)	39,230,121	19,241,878	58,471,999
Percentage of total output cut by machines	18	56	23
Number of conveyors at coal face	1,771	414	2,185

Correspondence.

Correspondents should forward their communications as early as possible. *No letter can be published unless we have the writer's name and address in our possession.*

Radio Valve-anode Capacitive Resistance.

Referring to Mr. Ernest W. Braendle's most interesting article in this week's issue of your paper, entitled "Radio Valve-anode Capacitive Resistance," I beg to submit the following comments on his statements therein.

He says that the present methods of calculating triode valve output circuits are incorrect. The crux of the whole matter appears to be that he states that the signal currents in a valve's anode circuit are set up by variations in its internal slope resistance, and not by the direct generation of a.c., as occurs in a generator, and that therefore they are not capable of analysis by the methods at present in use. Even after reading his article very carefully, I cannot see that this is so.

From Mr. Braendle's own words I take it that he admits that the usual methods of vector analysis will apply to such a circuit as that shown in fig. 1 herewith. Here the a.c. generator G sends a current through r and also R and C in parallel. The latter takes current leading the voltages by 90 degrees. In the resistances the current is in phase. The combination R and C acts as a vector impedance equalling

$$1/(1/R+jC.2\pi f)=Z \quad \text{.....(1)}$$

The impedance of the whole circuit is

$$1/(1/R+jC2\pi f)+r=Z \quad \text{.....(2)}$$

The voltage across Z is of sine-wave form, as is that generated by G. The inclusion of a d.c. battery in circuit will have no effect whatever on the a.c. conditions. This is simply the usual theory.

Mr. Braendle's analysis is based on the false assumption that the slope resistance of the valve is varied by its grid potential, and so gives rise to the amplified signal current

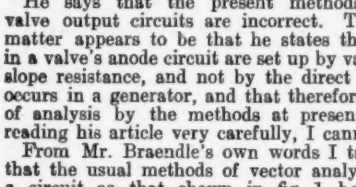


Fig. 1.

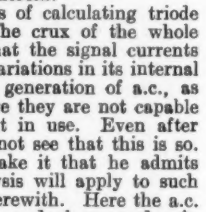


Fig. 2.

in its anode circuit. (If this were so varying, the negative grid bias of an amplifying valve over the straight portion of its grid-voltage/anode-current curve would vary its slope resistance—which, of course, it doesn't.)

The actual fact is that the grid potential varies the *potential slope* across the slope resistance of the valve, by an amount depending on the characteristics of the type of valve.

Consider fig. 2. Here we have a valve amplifying circuit, with the slope resistance R in series with the reactive impedance Z, which has a d.c. resistance of r ohms. The h.t. battery has an e.m.f. of E volts. The valve has a d.c. resistance of R_i ohms.

Let the grid volts equal zero.

Then there will be a direct current flowing in the anode circuit equalling $E/(R_i+r)$. From Kirchoff's law E must always be balanced by a back, or negative, potential difference—e, such that

$$e=I_p(R_i+r) \quad \text{.....(3)}$$

Now let the grid voltage be varied by an amount $+$ or $-$ v_g; then, by elementary valve theory, the potential slope across R_i will be varied by an amount $+$ or $-$ μv_g volts (where μ=the amplification factor of the valve). By equation (3) above, $E-e$ must equal zero, and the only way this can be the case is for I_p to vary by an amount

$$+ \text{ or } - \mu V_g/(R_i+r)=dI \quad \text{.....(4)}$$

that is

$$E/R_i + \text{ or } - \mu V_g/(R_p+r)=dI+I_p \quad \text{.....(5)}$$

But let v_g be an alternating e.m.f., and of sine-wave form then the anode current will equal, obviously,

$$E/R_i+\mu V_{g\,max.} \sin 2\pi f/(R_p+Z)=I_p+dI \quad \text{.....(6)}$$

clearly an ordinary alternating-current superimposed on direct, for which the normal formulæ hold, thus disproving Mr. Braendle's theory.

But just for curiosity let us see what happens if the grid voltages are supposed to vary the anode slope resistance as suggested. If the maximum variation is dr, the current at any instant will equal

$$E/R_i+E/(R_p+Z+dr \sin 2\pi f)=I_p+dI \quad \text{.....(7)}$$

Or, in other words, there will be an alternating current of sine-wave form superimposed on the direct current I_p, and I, personally, can see no difference between these conditions and those in my sketch (fig. 1) as regards the alternating quantities involved, or why the same formulæ should not be applied to them both.

I submit that the true reason for any discrepancy between theory and practice which Mr. Braendle mentions in his first paragraph is due to the fact that, to keep them simple enough to be manageable, the usual expressions do not allow for the transients in telephony. Such impulses are produced by any discontinuous tone, such as that of the piano, voice, or the "effects" in a play, and they are not of sine-wave form.

For instance, suppose we remove the generator from the circuit of my sketch, and, instead, inject a voltage surge of nearly vertical wave-front into it. The condenser will charge and then discharge logarithmically, as Mr. Braendle states, and the output voltage across it will not follow the original wave-form, hence giving distortion. Here, obviously, the ordinary formulæ, with their sine-wave assumption, do not hold.

Looked at in this light the article in question is most interesting, and if Mr. Braendle, when his work is completed, gives us a practical formula covering transients, he will have made an achievement indeed. In this connection, before practical results could be obtained, the acoustic, as well as the electrical, apparatus of telephony would have to be carefully looked into.

I hope Mr. Braendle and any others interested will do me the honour of giving their opinions on my statements in this rather long letter.

J. H. Owen Harries.

Frinton-on-Sea, *August 11th*, 1928.

Past and Present Conditions of Jointing.

In answer to "Cairngorm's" letter in your issue of August 3rd, I may say that my contribution was not intended to be a subject of controversy as to ability, proficiency, or methods of jointing, but to convey the considered opinion of many jointers actively engaged in the trade who do not want this agitation on their behalf, and who, for "Cairngorm's" information, are also contributing to the upkeep of the officials who are negotiating. He is right about the hourly pay 1s. 9½d. —not "palm oil," as he terms it; as he mentions Southern-Hemisphere licences of proficiency, I would call his attention to Southern-Hemisphere palm oil with its dire results to the recipient (*vide* the Sydney Press); we only get the pay he mentions. Also the average mains superintendent doesn't want any licence after he has seen a jointer at work for an hour or so, and he will relieve "Cairngorm" of all his worry and apprehension incidental to super- or any other tension jointing, if he follows instructions.

"Cairngorm" asks what sort of services we "dab in" at 2 a day; we don't dab any in, but under the supervision of first-class mains engineers connect up 2 twin off 3- or 4-core distributors quite easily in the working day. Also, in changing over, we take off 2 concentric and replace with twin in the same time, sometimes 3 with an hour extra; armoured clamp boxes, 3 a day.

He asks where are the 3-yard services; in the Northern industrial towns the distributors are laid close to the building line in numerous cases—but surely he ought to know this.

Plumber-Jointer.

August 3rd, 1928.

Electrical Plant in Workshops.

I have read with great interest a letter in the current issue of the Electrical Review by Mr. H. M. Goody, publicity manager for a well-known firm of switchgear makers. Permit me to heartily congratulate this gentleman, who is certainly skilled in the art of publicity.

I shall make a point of carefully scanning the correspondence columns each week, in case there happens to be a further contribution from Mr. Goody's pen. He has certainly taught us how to obtain a good advertisement free of charge.

R. J. Millard.

Leeds, *August 11th*, 1928.

Does it Pay to Acquire Knowledge?

I was very interested in the letter by "Ambitious," appearing in your current issue, entitled "Does it Pay to Acquire Knowledge?"

I am sorry to say that I cannot offer him advice, as I am in a practically parallel position. My education, both general and technical, was at colleges of good standing. I have obtained exemption from the A.M.I.E.E. examination by submitting a thesis on research work; served a regular pupilage with a well-known firm of consulting engineers, and obtained workshop and test-bed experience with a good manufacturing

firm. In addition, I have had three years' subsequent manufacturing experience, both on the technical and sales side.

My salary is only slightly higher than that of "Ambitious"; I am nearly 30 years of age, and married.

Like your correspondent, I am seriously considering studying for the Honours B.Sc. (Engineering) degree of the University of London, in my spare time, with a view to entering the teaching profession, or in the hope of securing a good Government appointment, but I, too, wonder if the work and expense involved would be rewarded.

I only hope that those of your readers who have views to offer on the subject will let "Ambitious," myself, and others in a similar predicament benefit by their expression.

Interested.

August 12th, 1928.

Electric Refrigerators.

"Contractor" must surely be waiting for the refrigerator business to come to him instead of going out for it. In this town of 4,600 inhabitants we have sold six refrigerators this season in co-operation with the Electrolux Co., for whose refrigerators we became "authorised distributors."

We have two different sizes in stock, one of which we keep working, and we expect to clear both of these at least before the end of the season.

Our buyers have been: Four private houses; one cooked-meat shop; one private hotel.

C. Culmer Hodges.

Electricity Works, Dawlish.
August 13th, 1928.

A New Use for the Portable Wireless Set.

Mr. Palbi, in his letter (July 13th), states that there is a perceptible lag between the original sound and the received sound. I have seen it stated that at a certain distance from Big Pen broadcasting reception leads the bells by a clear margin. Do these statements point to the deduction that the wireless time factor is a constant for all distances, giving a lag for short distances and a lead for long?

W. J. Whinton.

Ilford, *August 10th*, 1928.

[Wireless transmission from the microphone is practically instantaneous; hence the original sound will lead if the observer is nearer to the source than the microphone is, and will lag if he is farther away than the microphone.—Eds. Elec. Rev.]

Shoddy Wiring.

Enclosed please find sections of cable which I took out of a shop in Sheffield. As you will see, comment is needless. I had to rewire the whole of the installation, as there were six places where the cable had burnt through owing to the tubing not being earthed, and minus tees or bends. Is it not time that only authorised persons should be allowed to do electrical work?

A Reader.

August 13th, 1928.

[The samples show that the material was good, but "workmanship" was wholly absent. That such scamped jobs should exist is certainly deplorable.—Eds. Elec. Rev.]

"Aged 36" is requested to send us his name and address.—Eds. Elec. Rev.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1927.

1,855. "Exploring devices for television apparatus." Television, Ltd., and J. L. Baird. January 21st, 1927. (294,267.)

5,619. "Electric signalling systems." A. K. Croad (J. T. Rankin). July 5th, 1927. (293,948.)

6,745. "Vacuum electric tube devices." E. Y. Robinson and Metropolitan-Vickers Electrical Co. Ltd. March 10th, 1927. (Cognate applications 25,048/27 and 25,140/27.) (294,125.)

10,176. "Quick-acting electric switches." Siemens Schuckertwerke Ges. (in liquidation) April 23rd, 1926. (269,895.)

10,453. "Electric heating of metal prior to rolling." B. Witting. April 19th, 1927. (294,157.)

10,723. "Electric coupling devices." General Electric Co., Ltd., and J. H. Collings. April 21st, 1927. (294,278.)

10,748. "Incandescent cathode rectifiers." F. Meyer and H. J. Spanner. August 20th, 1926. (276,303.)

10,758. "Sparking plugs." K. E. L. Guinness. April 21st, 1927. (294,280.)

10,811. "Electro-therapeutic apparatus." J. H. T. Roberts. April 22nd, 1927. (294,283.)

10,860. "Electro-acoustic devices." H. J. Round and N. M. Rust. April 22nd, 1927. (294,285.)

10,884. "Mercury-vapour arc lamps." G. J. Blake and G. D. G. Leadbetter. April 23rd, 1927. (294,288.)

11,176. "Method of and apparatus for resistance welding." Electrical Research Products, Inc. May 22nd, 1926. (271,431.)

11,212. "Headlights for motor vehicles and the like." A. Ringham. April 27th, 1927. (294,292.)

11,241. "Electromagnetic sound-reproducing devices." Sir J. G. Maxwell, G. R. Westmacott, and F. E. Foster (legal representatives of Sir C. S. Forbes, deceased). April 27th, 1927. (294,294.)

11,823. "Frame aerials for use in radio receiving apparatus." P. Perring-Thoms. May 3rd, 1927. (294,300.)

12,387. "Terminals or couplings for electric wires." A. A. Linsell. May 9th, 1927. (294,305.)

12,650. "Speed-regulation of synchronous motors." British Thomson-Houston Co., Ltd. May 11th, 1926. (271,084.)

12,700. "Incandescent cathode rectifiers." F. Meyer and H. J. Spanner. October 15th, 1926. (Addition to 276,303.) (279,024.)

13,110. "Electric coupling devices." General Electric Co., Ltd., and R. J. Kaula. May 16th, 1927. (294,317.)

13,307. "Switch and bank for automatic telephone exchanges." J. P. Lowe. February 17th, 1928. (294,321.)

14,816. "Electric switches." R. C. Graseby. June 2nd, 1927. (294,336.)

15,134. "Wireless condensers and the like." F. Lafont. June 7th, 1927. (Patent of addition not granted.) (294,342.)

16,265. "Automatic or semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd., and R. Taylor. June 18th, 1927. (294,351.)

18,789. "Method and apparatus for using telephone subscribers' loops for transmission and reception of broadcasting." G. O. Squier. July 17th, 1926. (274,491.)

18,843. "Electric starters for internal-combustion engines." R. L. Aspden. July 15th, 1927. (294,369.)

20,181. "Electric fuseholders." British Thomson-Houston Co., Ltd., and D. H. Graham. July 29th, 1927. (294,380.)

21,281. "Spark ignition apparatus for internal-combustion engines." M.-L. Magneto Syndicate, Ltd., and E. A. Watson. August 12th, 1927. (294,386.)

22,676. "Grid controls for thermionic electric valves." R. Kapp. August 28th, 1926. (276,695.)

23,029. "Electric pocket-lamp with lever switch." A. E. O'Dell (Elektrotechnische Fabrik Schmiet & Co., Ges.). September 1st, 1927. (294,393.)

23,664. "Radio communication." Dubilier Condenser Co. (1925), Ltd. September 8th, 1926. (277,053.)

27,899. "Indicating devices." British Thomson-Houston Co., Ltd. October 23rd, 1926. (279,473.)

28,197. "Method and arrangement for obtaining a perfect high vacuum in electric discharge tubes." Dr. S. Loewe. October 26th, 1926. (279,842.)

28,659. "X-ray system." F. S. Smith. October 27th, 1927. (294,408.)

28,660. "X-ray system." F. S. Smith. October 27th, 1927. (294,409.)

30,589. "Method of manufacturing rubber-covered cables for the transmission of electric power." Felten & Guilleaume-Carlswerk Akt. Ges. November 12th, 1926. (280,600.)

30,678. "Devices for coupling signalling current generators to low-frequency electric supply systems." Compagnie pour la Fabrication des Compteurs et Materiel d'Usines a Gaz. November 27th, 1926. (281,275.)

30,720. "Prepayment meters for electricity." Siemens-Schuckertwerke Akt. Ges. November 18th, 1926. (280,921.)

31,770. "High-tension electric insulating bushings." Quartz & Silice. December 3rd, 1926. (281,734.)

31,853. "Battery containers." A. M. Maclachlan. November 26th, 1927. (294,416.)

34,200. "Furnace electrodes." Soc. Electro-Metallurgique de Montricher. December 21st, 1926. (282,672.)

34,472. "Starting arrangements for synchronous convertors." Allmanna Svenska Elektriska Aktiebolaget. December 2nd, 1927. (294,429.)

1928.

727. "Electric floor polisher." W. Rapp. January 9th, 1928. (294,435.)

2,571. "Train-controlling systems." Siemens & Halske Akt. Ges. October 12th, 1927. (294,444.)

5,593. "Resistance grids for electrical purposes." Crompton Parkinson, Ltd., and G. Page. February 22nd, 1928. (294,452.)

7,467. "Resilient mounting for acoustic signalling apparatus on vehicles." R. Bosch Akt. Ges. May 21st, 1927. (290,969.)

8,385. "Plate supports and separators for accumulators." Concordia Elektrizitats Akt. Ges., and W. Gosmann. March 19th, 1928. (294,458.)

13,951. "Synchronisation of electrical devices." British Thomson-Houston Co., Ltd. May 13th, 1927. (290,298.)

Trade Mark Applications.

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from August 8th.

Unigen. No. 492,267. Class 8. Instruments and apparatus for use in wireless telephony and telegraphy.—Universal and General Radio Co., Ltd., 1-42a, Bravington Road, W.9.

Ardent. No. 489,753. Class 13. Lamps.—Société Chauffage et Eclairage Sepulchre, 267, Rue St. Lambert, Herstal, Belgium. (British representatives: H. N. & W. S. Skerrett, 24, Temple Row, Birmingham.)

Greyhound (lettering and design). No. 491,981. Class 13. Driving chains and similar chains and sprocket wheels used in connection therewith.—Hans Renold, Ltd., Burnage Works, Didsbury, Manchester.

The International Illuminating Congress.

Elaborate arrangements are being made for the forthcoming "first world congress on illumination," which is to be held in connection with the plenary meeting of the International Commission on Illumination at Saranac, New York, U.S.A., next month. The White Star steamship *Pennland* will leave Southampton on August 25th, conveying a large European delegation, and a tour of places of lighting interest in the United States, from September 5th to 17th, will precede the opening of the Convention of the Illuminating Engineering Society at Toronto, Canada, September 17th to 20th. The Commission will sit from September 22nd to 28th at Saranac. At the head of the British delegation will be the president of the British National Committee, Mr. C. C. Paterson, and the central office is at the National Physical Laboratory (hon. secretary, Dr. J. W. T. Walsh).

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

AUDENSHAW (Manchester).—Houses (22), Kingsley Grove, for Hadfield & Revell.

AYRSHIRE.—Extensions (including science room) at St. Michael's College, Irvine; clerk, Education Authority, Ayr.

BATH.—Business premises, for the Bath and Twerton Co-operative Society; secretary.

BERKHAMSTED (Herts.).—Institution, Ashlyns estate, for the Foundling Hospital, Guilford Street, London, W.; R. H. Nichols, secretary, Redhill.

BEXHILL.—Alterations to Winceby House School, South Cliff; C. Kerridge, junr.

BEXLEY HEATH.—Houses (52), Warwick Road, Welling, for J. Stevens & Sons.

BOSTON.—Additional 20 houses, Skirbeck, for the R.D.C.; surveyor.

BRAINTREE.—School, Chapel Hill, for Essex E.C.; J. Stuart, county architect, Chelmsford (returnable deposit of £2 2s.).

BROMLEY (Kent).—Housing scheme (56), for the R.D.C.; surveyor.

BURSLEM.—Extensions, Elder Works, Waterloo Road; Soho Pottery, Ltd.

BURTON LATIMER.—Additional 20 houses, for the U.D.C.; surveyor.

CHEADLE.—40 houses. Oak Road housing site, for the U.D.C. (deposit, £2 2s.); surveyor, Council offices.

CHELMSFORD.—Market improvements; borough engineer.

CHERTSEY.—Houses (50), for the U.D.C.; W. J. Drowley, builder, Bath Road, Woking.

CHRISTCHURCH.—School; Hampshire Education Committee.

COULSDON.—Extensions to mental hospital, with accommodation for 600 patients, for Surrey C.C.; clerk, Kingston-on-Thames.

DAGENHAM (Essex).—Church and social hall, Becontree Avenue, for Essex Baptist Association; secretary, Catholic schools, Goresbrook Road; Lord Bishop of Brentwood.

DARTFORD.—Additional 62 houses, for the R.D.C.; surveyor.

DONCASTER.—Roman Catholic Church, Rossington; James Horkin & Sons, builders, Liversedge.

DOUGLAS (I. of M.).—Sheds, railway station; Isle of Man Railway Co.

DOVERCOURT.—Bandstand (£10,000); Harwich borough engineer.

DUMFRIES.—Business premises, Loreburn Street, for W. B. Anderson & Sons, Ltd., and Queensberry Square, for P. T. Ferguson, Imperial Restaurant.

EDINBURGH.—Cinema at Piershill Terrace; R. A. Craig. Cinema, for Provincial Cinematograph Theatres, Ltd.; the secretary. Additions to cinema, for Playhouse (Edinburgh), Ltd., Greenside Place; the manager.

ELTHAM.—Extensions, Eltham College; Governors.

FALKIRK.—Sub-station and other buildings for Grangemouth Iron Co.; J. M. Primrose, manager.

FELTHAM.—Houses and flats (250), Poors Land site, for U.D.C.; J. P. Blake, architect.

GLASGOW.—Additions to Holm Foundry, Cathcart, for G. and J. Weir, Ltd.; the manager. 200 houses, for Corporation at Gairbraid Avenue; Housing Director. Additions to works at Scotstoun, for Albion Motor Car Co.; the manager. Shop and offices, for Cowlairs Co-operative Society, Ltd., 27, Angus Street; the manager. Hall in Springburn, for Amalgamated Society of Locomotive Engineers and Firemen; the secretary. Additions to hospital, for the Royal Samaritan Hospital for Women; medical superintendent. Additions to Glasgow Royal Cancer Hospital, Thistle Street; medical superintendent. Reconstruction, Granite House, Stockwell Street (£5,000); Frank Burnet & Boston, architects. 382 houses, Balornock estate; Housing Director. 552 houses, Meikle Aitkenhead; Breeze, Paterson & Chapman. Gas department offices, Sauchiehall Street; gas manager.

GORTON (Manchester).—School for Lancs. E.C.; director of education, Preston.

HAMILTON.—Magistrates' courthouse, offices, &c. (£29,000), for Lanarkshire C.C.; P. C. Smith, architect, public offices, Hamilton.

HASTINGS.—Offices, for borough engineer, with central heating, &c. (£2,821), for the T.C.; borough engineer.

INCE-IN-MAKERFIELD.—Housing scheme (48), for the U.D.C.; W. Thornley, architect, 46, Wallgate, Wigan (returnable deposit of £1 1s.).

IRISH FREE STATE (Dublin).—Houses (24) and two shops, Upper Drumcondra; J. J. Flanagan, builder, Drumcondra.

(Lisdoonvarna, Co. Clare).—Mineral baths, for the Spa Trust Committee; J. Mackey, quantity surveyor, 58, Dame Street, Dublin.

LEEDS.—Adapting Meanwood Towers for hospital annexe; city engineer. Bridge over Whitehall Road; Mock Bridge Iron and Steel Co., Ltd. 190 houses, Hawksworth Wood estate; city engineer. Housing scheme, Beckett Park estate, Headingley; city architect.

LEWES.—Extensions to county hall (£55,000), for East Sussex C.C.; county surveyor.

LONDON (Ilford, E.).—Extensions, Isolation Hospital, Medical officer of health. Paper store, Grove Road; C. Morgan & Co., Ltd.

LUTON.—Girls' school (£58,000), for Beds E.C.; director of education, Bedford. Hat factory, Melson Street, for Robinson & Butt (£15,000 to £20,000).

MARKET HARBOROUGH.—Classrooms, Collegiate School; W. H. Pearce Batten.

MILTON (Staffs.).—Extensions, rolling mills, British Aluminium Co.

NEWCASTLE.—'Bus stations; city engineer. 248 houses, Lonnen estate; Nordmann & Sons, Ltd. 127 houses, Lonnen estate; J. W. Hood & Co., Wallsend.

NEW MALDEN.—Extensions, St. Joseph's Roman Catholic Church (£5,000); J. R. Offer & Sons, builders, Kingston-on-Thames.

PAIGNTON.—Hospital extensions (£12,000); S. Batten & Son, builders.

PAULTON (near Bristol).—Isolation hospital for Bath, Clutton, Midsomer Norton and Radstock Joint Hospital Committee (deposit £2 2s.); A. J. Pictor, architect, Bath.

PENZANCE.—Joint infectious diseases hospital; West Penwith R.D.C.

PETERBOROUGH.—Public baths (£16,000), for the T.C.; city engineer.

PURLEY.—Church for St. Mark's Parochial Council; Sydney Jupp, architect, Woodcote Village.

SELSDON (Surrey).—20 houses, Brent Road; Walton Heath Land Co.

SHARDLOW.—Six housing schemes (200), for the R.D.C.; J. S. Wooddisse, surveyor, 4, Full Street, Derby (returnable deposit of £2 2s. for each scheme).

SHEERNESS.—Extensions, technical institute, for Kent E.C.; W. H. Robinson, education architect, Sessions House, Maidstone (returnable deposit of £2 2s.).

SHEFFIELD.—Waterworks (£200,000); water engineer.

STOKE-ON-TRENT.—Four storey factory, Sideway Road; Michelin Tyre Co., Ltd. Maternity centre, Trent Vale; city engineer. Alterations, St. Peter's Central School, Church Road; Church managers.

STOURPORT.—Factory and offices, Bewdley Road, for the Steatite and Porcelain Products Co.

TILBURY.—Cinema, for Ingram & Oliver.

TUNBRIDGE WELLS.—Houses (32), with electrical work, for the T.C.; Lewis Thorpe, builder.

TUNSTALL.—Oil depôt, Cross Street; Sealand Petroleum Co., Ltd.

TYNEMOUTH.—Extensions, Tynemouth Traction Co.'s 'bus garage, Norham Terrace; Marshall & Tweedy. Alterations, for National Provincial Bank, Ltd., at Bedford Street; F. R. N. Haswell & Son, architects. Slaughter houses, Stormont Street; L. Scott & Sons.

WESTBURY.—Senior school for Wilts. E.C.; W. Pullinger, director of education, Trowbridge.

WESTON (Leamington Spa).—Conversion of reformatory school into mental defectives' reception home, for Warwickshire C.C.; clerk, Warwick.

WOLVERHAMPTON.—Extensions, including ballroom, with central heating, &c., Victoria Hotel; Scott & Clarke, architects. Wednesbury; H. Gough & Son, and Albert Liddall, Hednesford, builders.